ELECTRICAL REVIEW

AN ILLUSTRATED WEEKLY JOURNAL OF SCIENTIFIC AND ELECTRICAL PROGRESS.

VOL. 32. No. 24. WEEKLY. NEW YORK, WEDNESDAY, JUNE 15, 1898. $3 PER ANNUM. SINGLE COPIES, 10 CENTS.

Copyright, 1898, by ELECTRICAL REVIEW PUBLISHING COMPANY, Times Building, 41 Park Row, New York.

Entered at the Post Office, New York, as Mail Matter of the Second Class.

VIEWS, NEWS AND INTERVIEWS.

When a mail steamship ran into Honolulu the other day with the news that the United States cruiser "Charleston," with three transports carrying over 2,000 troops bound for Manila, was on the way into the harbor, a committee of 100 of the leading men of the republic was formed to welcome the United States soldiers and sailors. The city was decorated and a large drill-hall was converted into a great dining-room to feast the military. A unique feature of the celebration was the fact that the electric light station announced the sighting of the cruiser and transports by five rousing blasts from its big whistle. When the whistle was let go the whole population of Honolulu moved toward the harbor and gave the fleet a royal welcome.

The government censorship on cable dispatches has been modified to the extent of allowing commercial houses to send code messages to Venezuela and Brazil. The only restriction on these messages is that they shall not pass between the Spanish officials.

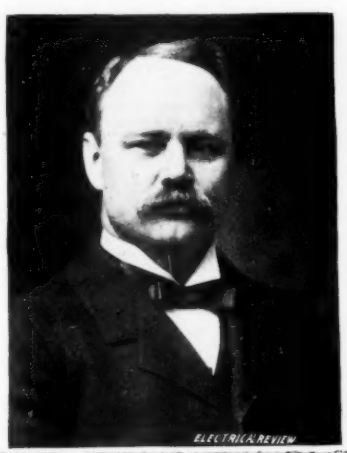
In an English exchange, Mr. F. J. Jervis-Smith, of Oxford, describes a method of using electric lighting wires as telephonic circuits. He was requested some time ago to try to localize a fault in an electric light main, by means of a certain form of inductor used in conjunction with a telephone, but not connected to the main. While using it, it occurred to him that probably the main might be used instead of a telephone wire. His first experiments were not productive of good results, as a small fraction of the company's current passed continuously through the telephone. In October, 1897, he placed one-third microfarad condensers in his telephone circuit at each end; these stopped the current, but in no way reduced the telephonic effects. If the note given out by virtue of the rotation of the armature of the dynamo is great, it can be very greatly reduced by placing an inductively-wound resistance in the circuit. The resistance, he writes, does not appear to modify the telephonic effects in any marked degree. This probably arises from the fact that the electromotive force, due to the secondary coil of the telephone transmitter, is high. The experiment was successfully made over two miles of a main which was carrying the full load used in lighting the town.

It is said that the most widely separated points between which a telegram can be sent are British Columbia and New Zealand. The telegram would cross North America, Newfoundland, the Atlantic, Britain, Germany, Russia (European and Asiatic), China, Japan, Java and Australia. It would make nearly a circuit of the globe, and would travel over 20,000 miles in doing so.

The War Department telegraph office is provided with a large switchboard with 25 independent wire connections, being a miniature of the large switchboard in the main office of the Western Union Telegraph Company. There is also a complete system of loops whereby the Secretary of War and his assistant are enabled to communicate almost directly with all telegraphic points in the world. This is in addition to the direct communication afforded by the government wires connecting the War Department with the White House, the Capitol, all the executive departments and the army posts of Fort Myer and Washington Barracks.

An English contemporary says that a well known counsel, a familiar figure in electrical lawsuits, was examining a youth the other day, and asked him if he knew the nature of an oath. "Don't I just!" replied the boy, with evident glee. "Wasn't I your caddie for three days when you wos playin' golf a few weeks ago; and then you arst me, Do I know the nature of an oath!"

During the bombardment at Matanzas on April 27, the electrical ammunition hoists and turret-turning gear of the "New York" worked admirably. This news is especially gratifying to those who contended that the electrical transmission of power on shipboard is as reliable as it is convenient and economical.



MR. A. M. YOUNG, OF WATERBURY, CT., THE NEWLY ELECTED PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.—(See page 389.)

ELECTRIC LIGHT MEN.

The Twenty-first Convention of the National Electric Light Association Concludes Its Work in Chicago.

PAPERS OF MUCH PRACTICAL IMPORTANCE PRESENTED AND DISCUSSED—ABLE ADDRESSES ON DISTRIBUTION FROM CENTRAL STATIONS BY ALTERNATING AND DIRECT CURRENTS PROVOKE LIVELY ARGUMENT AND RECITAL OF EXPERIENCES—THE NEXT MEETING TO BE HELD IN NEW YORK CITY, AND MR. A. M. YOUNG ELECTED PRESIDENT FOR THE ENSUING YEAR.

The ELECTRICAL REVIEW published last week an account of the first day's proceedings of the convention of the National Electric Light Association, at Chicago, and presented many notes of interest relating to this important gathering. The sessions continued during Wednesday and Thursday of the week, and while the papers and discussion are too lengthy to all appear in one issue, a general review of what was done appears below, and further publication will be made of the addresses and discussion more in detail.

Wednesday's Proceedings.

Under the "topic" of "Legislative Policy as to Public Service Corporations," papers were presented Tuesday afternoon by H. M. Atkinson, E. H. Davis and Mr. Scovil.

On Wednesday morning the session opened with a good attendance.

President Insull called the meeting to order at 10.30 A. M., and announced that the papers for the morning session would be that on "General Distribution from Central Stations by Alternating Currents," by Herbert A. Wagner, of St. Louis, and "General Distribution from Central Stations by Direct Currents," by Louis A. Fergu-

son, of Chicago. The papers were read by the respective authors.

The President: I have pleasure in calling upon Professor Fujioka, one of our honorary members, who is Professor of Electrical Engineering at the Imperial University, of Tokio, Japan.

Professor Fujioka: Mr. President and Gentlemen—In opening this discussion I wish to give some description of what we have done in Japan. Although I have the honor to be an honorary member of your association, I have very little opportunity to attend your conventions. I shall take great pleasure this morning in giving a short description of the plant and system which has been carried out under my direct supervision in Japan. I have no data to be compared with the papers which have been read, so I will draw a rough map of Tokio. We originally had five central stations. No. 1 station was originally installed in 1888, entirely with the Edison three-wire system. Nos. 2, 3, 4 and 5 were installed afterwards, also on the Edison three-wire system. Before going further I would like to say that there are some conditions peculiar to Japan; that is to say, the city of Tokio has quite an extended area, occupying about 100 square miles, and the buildings are scattered, and we have no high buildings because of the danger from earthquakes. I saw the advantages of the Edison three-wire system of distribution, so we began to supply the more crowded parts of the city by means of the three-wire system. We subsequently found that it was necessary to supply current to more settled parts of the town, so we added single-phase alternating current in most of the other stations. Since we saw the advantages of the three-phase current transmission we have decided to install one big power-station near the river. All the former stations were worked with high-pressure non-condensing engines, and I may state that coal in Japan, particularly in Tokio, is very expensive, costing $5 to $6 a ton. So we found that it might be wiser to install a condensing station near the river, having triple expansion engines. We installed 10 triple expansion engines on the condensing system, each engine directly coupled to low-speed generators, four of them single-phase and six of them three-phase generators. The three-phase generators were wound for 3,500 volts, whereas the single-phase were wound for 2,000 volts. We did not like to disturb the existing three-wire network in this crowded portion of the city, and we wanted to keep the three-wire network as we have had it for about 10 years. The way I have done it was to place induction motors in No. 1 station, taking out all the engines and boilers, and placing the induction motors in the place where we had the engines. So in the same way station No. 3 was converted in a similar way, and in station No. 2 we have four induction motors, each 150 horse-power, directly connected to multi-phase, direct-current dynamos. No. 4 station was taken down altogether. In No. 5 station we took down all the old engines and dynamos; we replaced the three-phase transformers with the four-wire system for alternating current. The other parts are coupled by means of 2,000 volts, single-phase current, raising the voltage at the necessary place to the required potential. In that way we have succeeded in reducing a great deal of the expense in fuel and labor items. I can not tell at present the exact proportion of the decrease, but we know we have reduced the expenses materially, and I shall be much pleased if this brief description will convey to you some idea of what has been done in Japan. (Applause.)

President Insull then announced a general discussion on the subject of alternating and direct currents for electric lighting.

The discussion that followed was greatly protracted. It extended through the forenoon session and the greater part of the afternoon and was participated in quite generally by all the central station men. Among the debaters, in addition to the authors, were Messrs. Van Trump, Robinson, Dow, Wilmerding, Scovil, Insull, Ayer, Davis, Stetson, DeCamp, Thayer, Chandler, F. E. Smith, Walbank, and Carnes. The discussion was closed by Messrs. Ferguson and Wagner, the authors

The meeting then adjourned until Thursday morning.

On Wednesday evening, Mr. Joseph Wetzler delivered a lecture on "Electricity Direct from Coal," illustrated with stereopticon views. The lecture was well attended.

Thursday Morning Session.

President Insull called the meeting to order at 10.40 A. M. The first paper read was on the "Cost of Producing Electric Power by Water-Power from Lachine Rapids, Canada," by Mr. W. McLea Walbank, of Montreal, Canada.

Discussion was entered into by a number of gentlemen, after which a very interesting paper was read by Prof. Winder Elwell Goldsborough, on "Transformer Economy," which was also discussed at some length.

At this point the chair appointed the following committee to nominate officers for the ensuing year: A. M. Robertson, Minneapolis, Minn.; Jas. R. Dee, Houghton, Mich.; Jas. I. Ayer, Boston, Mass.

The meeting then adjourned until 2.30 P. M.

Thursday Afternoon Session.

President Insull called the meeting to order at 2.55 P. M. The first business was the report of the committee on "Standard Candle-Power of Incandescent Lamps," Dr. Louis Bell, chairman. Mr. Ayer presented the report of the committee as follows:

Your committee has been able to have tested in the most careful manner through the courtesy of Prof. W. L. Puffer, of Boston, 16 incandescent lamps from 11 different makers. The lamps were obtained directly from the makers or their authorized agents and were known to be for test.

These lamps were all sold for 16 candle-power, 110 volts, no watts specified, and may be fairly assumed to represent the product which would be shipped to consumers who did not desire the lamps for test, although one batch of lamps came with the bases marked to show the point to be turned toward the photometer screen.

On test these lamps, 33 in all, averaged 14.1 mean normal candle-power, and about 11.7 mean sph. candle-power. Only one batch of three averaged over 16 normal candle-power. One batch fell below 11 normal candle-power and two below 12 normal candle-power. Five makers fell below 14 5 normal candle-power. The highest average of any batch was 16.99, the lowest 10.82. The average consumption of energy was almost exactly four watts, the lowest 3.76 watts per candle and two batches ran over five watts. It should be noted that the voltage was determined by a Weston voltmeter, freshly compared with Clark cells, and each lamp was marked at its marked voltage (110).

A separate series of tests showed that these lamps on the average gave their mean sph. candle-power, when measured under rotation with their axes tilted 44 degrees and 24 minutes from the vertical toward the photometer, thus confirming closely your committee's estimate of 45 degrees as a proper angle.

A series of tests on proper speed of rotation showed that the best results were obtained with a speed of 200 to 250 revolutions per minute, and that the lamps would readily stand this speed.

Many of the lamps showed bad spherical distribution, which seems to be quite needless, since it is merely a matter of proper proportioning the form of the filament.

Of an equal number of batches of 32-candle-power lamps only one batch averaged 32 normal candle-power, the majority falling to from 26 to 28 candle-power. The 32-candle-power lamps averaged slightly greater efficiency, but were otherwise much like the 16 candle-power size.

From this investigation the fact stands out that the incandescent lamp sold for 16 candle-power is, on the whole, a lamp which is often giving considerably less than its rated candle-power even when new. Some of these lamps would probably show a temporary increase of candle-power after, say, 50 hours' burning, but the committee has not extended the research in this direction as yet, and adheres to the opinion that the initial candle-power is the only practicable commercial test, and any increase consequently is simply to be regarded as a device for keeping the lamp a little longer from its inevitable decay.

From these and other data, kindly furnished by manufacturers and obtained from various other reliable sources, your committee is convinced that the need of a uniform rating is even greater than it concluded in the preliminary report of last year, and that a rating test, in order to be effective, must involve measurement of candle-power of lamps in more than one direction. Neither mean horizontal nor mean spherical candle-power nor candle-power in any one direction will define a lamp well enough to insure adherence to the rating. Your committee therefore recommends that incandescent lamps be required to conform both to a standard mean normal candle-power and to a mean candle-power when revolved with the axis tipped 45 degrees, this representing the spherical distribution. It recommends that the limits for the mean normal candle-power be 15 and 17.5 candle-power; unless the minimum be as high as 15 there will certainly be found a tendency to produce lamps near the lower limit. The 45 degrees candle-power should be at least 85 per cent of this minimum. This is not an excessive requirement and will tend to prevent working near the lower limit of horizontal candle-power unless with a lamp very good in other respects.

Your committee has blocked out a standard form of photometer, a type of which it proposes to build, test and put at the disposal of the association, with directions for proper use.

It suggests that testing be by sample, a lot of 10 lamps being taken from each barrel. Of these, no lamp when run at its marked voltage shall show less than 15 or more than 17.5 candle-power mean horizontal, when rotated at 200 to 250 revolutions per minute, and no lamp shall give, when thus rotated at 45 degrees inclination, less than 85 per cent of the above minimum.

The committee will make arrangements for standard lamps as indicated in the preliminary reports to go with the standard photometer.

Mr. Burleigh: I move that the report of the committee be adopted, that this committee be discharged and another committee be appointed to continue the work. Carried.

The president appointed as a committee: James I. Ayer, of Boston; Louis A. Ferguson, of Chicago, and Calvin W. Rice, of Brooklyn.

The Committee on "Amendments to Freight Classification" requested further time to report, and the report was postponed until the next meeting.

The Committee on "Legislation Concerning Theft of Current" made a verbal report in which they stated that the committee had collected laws passed in 27 different states bearing on this subject and they recommended that the same be published for the benefit of the members of the association.

The recommendation of the committee was adopted, and a new committee was formed as follows: Chairman, E. A. Armstrong, of Camden, N. J.; James I. Ayer, of Boston, and A. W. Field, of Columbus, Ohio.

The meeting then adjourned to executive session.

The report of the secretary and treasurer was presented, showing the affairs of the association to be in a flourishing condition.

On motion of Mr. Armstrong the following resolution was adopted:

"*Resolved*, That the annual meeting shall be held in May or June in each year, alternately in the cities of New York and Chicago, unless otherwise directed by the executive, and on such date as the committee shall determine."

On motion of Mr. Atkinson a very hearty vote of thanks was passed to President Insull for his untiring efforts for the success of the Chicago convention.

Mr. Ayer moved that the thanks of the meeting be extended to the Chicago Edison Company, the Metropolitan West Side Elevated Road, the South Side Elevated Road, the Northern Steamship Company, the Chicago Telephone Company, the American Telephone and Telegraph Company, and all others who had extended courtesies to the convention, for their kindness in so doing.

Mr. Field moved a vote of thanks to the reception committee for their very considerate attention to the ladies accompanying the delegates to the convention.

The following officers were elected for the ensuing year:

President, A. M. Young, Waterbury, Ct.

Vice-president, E. H. Rollins, Denver, Colo.

Second vice-president, F. A. Gilbert, Boston, Mass.

Members of the executive committee in addition to those holding over: Samuel Insull, Chicago, Ill.; Samuel Scovil, Cleveland, Ohio; H. M. Atkinson, Atlanta, Ga.; F. A. Copeland, LaCrosse, Wis.

The convention then adjourned *sine die*, at 4.30 P. M.

THE DELEGATES AND VISITORS.

The following is a nearly complete list of those present taken from the official association register and added to by REVIEW reporters:

C. H. Wilmerding, Chicago, Ill.
S. T. Carnes, Memphis Light and Power Co., Memphis, Tenn.

(*Continued on page 392*)

THE NORTHWESTERN ELECTRICAL ASSOCIATION.

MIDSUMMER MEETING ON BOARD THE STEAMER "NORTHWEST," EN ROUTE FROM CHICAGO TO DULUTH.

The "Northwest" left Chicago Friday, at 12.30 P. M., with about 130 electrical passengers. The equipment of the magnificent steamer pleased every passenger, and every one greatly enjoyed the trip.

The first association meeting was held at 8 P. M., Friday, June 10, for the purpose of arranging a programme, President Copeland in the chair.

The secretary announced that stops would be made at Mackinac, the "Soo" and at Houghton, and that it was expected the steamer would reach Duluth Monday night, June 13; that there would be a reception tendered the members of the association at Sault Ste. Marie, and that there would be an inspection of the government canal especially arranged for the benefit of the members of the association; that there would also be a stop made at Houghton long enough to permit of a tour of the famous copper mines there, and that suitable arrangements had been made for that purpose; that the only requisite would be an association badge, which he was prepared to furnish to the members of the association and to guests at a nominal price.

Professor Ichisuke Fujioka, of Tokio, Japan, who has been sent by the Japanese Government to the United States for the purpose of investigating electrical progress here, was called upon for an address, and said:

"I do not wish to address the convention at length this evening, but, if it is desired, will at some future session say something on the subject of the electrical industry in Japan, adding some comments on the subject of electrical education there, as I think that these topics will be of some interest to you all, and as I am naturally, perhaps, more familiar with the situation of electrical matters in Japan than perhaps most of the gentlemen here could be expected to be." (Applause.)

It was announced that Prof. Elisha Gray, of Highland Park, Illinois, would deliver an address during the convention, at an early session.

The programme for the next regular session was made out, consisting of a paper on the subject of "Incandescent Lamps," by Mr. S. Everett Doane, the session to be held at 11 A. M., June 11.

The secretary announced also that an address would be delivered by Mr. A. J. Wurts, of Pittsburgh, at some session during the trip, and that other addresses would be announced later.

Arrangements were made to place a question box in position to receive queries for consideration and discussion during the sessions.

An adjournment was then taken until June 11, 1898, 11 A. M.

SATURDAY, JUNE 11.

The convention assembled at 11 A. M., about two hours before arriving at Mackinac, and Mr. Doane read a very interesting paper on the testing and voltage of incandescent lamps. Discussion followed, which will be presented with the paper.

Mr. W. F. Barker, gas commissioner of Massachusetts, delivered a brief talk on electrical matters from his point of view, after which the convention adjourned until Monday.

MONDAY, JUNE 13.

[*By Telegraph to the* ELECTRICAL REVIEW.]

CALUMET, MICH., June 13—The association was given a reception at Sault Ste. Marie on the arrival of the steamer "Northwest" Saturday evening. The delegates were addressed by the mayor and others. Responses were made by Prof. Elisha Gray and Secretary Mercein. The Canadian Pulp Works were visited and lunch served by Manager Clergue.

The party arrived at Calumet Monday, and spent the day visiting the great copper works at Calumet and Hecla. The process of mining, milling and smelting was of great interest to the electrical visitors.

There are in use two and one-half miles of engines of from 2,000 to 8,000 horse-power each. About 6,000 men are employed, one-half working under ground. The visitors were shown through the works by Electrician F. N. Bosson and Committeeman J. R. Dee. The "Northwest" sailed this afternoon for Duluth. The programme, already published, will be continued on the ship and at Duluth Tuesday.

THE ATTENDANCE.

The following is a list of the members of the association and their guests on the steamer "Northwest," Chicago to Duluth:

J. N. Ely, Atlanta, Ga.; B. B. Downs, Minneapolis; W. P. Upham, Chicago; A. L. Daniels, Aultman, Ohio; C. D. Wilkinson, W. S. Rugg, Chicago; Douglas Hapeman, Ottawa, Ill.; R. A. Willson, Marquette; Robert F. Carr, Chicago; Arthur Warren, Pittsburgh; J. W. Mabbs, C. S. Kehler, Chicago; E. H. Abadie, St. Louis; Charles P. Williams, J. B. Knutson, La Crosse; John S. Baker, Miss Eliza Cleland, Evansville, Wis.; Fred Brooks, Boston, Mass.; Morgan Brooks, Minneapolis; L. S. Randolph, Blacksburg, Va.; Herbert H. Dow, Midland, Mich.; J. W. Hull, Steubenville, Ohio; H. H. Brooks, Boston; J. H. Harding, La Porte, Ind.; Samuel Wilkinson, Northville, Mich.; R. M. Heskett, Green Bay, Wis.; Charles F. Frego, Hoopston, Ill.; James H. McGraw, New York; F. L. Perry, Chicago; P. H. Kerst, Racine, Wis.; W. D. Packard, Warren, Ohio; L. K. Comstock, Chicago; H. C. Slate, Milwaukee, Wis.; Wm. Chandler, Sault Ste. Marie; C. A. Ross, Chicago; C. Dystured, Monterey, Mexico; Geo. V. Williams, Chicago; Geo. Rex, St. Louis; A. G. Paul and wife, Chicago; H. S. Anderson, Springfield; Geo. A. McKinlock, Chicago; W. L. Candee, New York; Elisha Gray and wife, Highland Park, Ill.; A. E. Lang and wife, Cleveland, Ohio; A. J. Wurts and wife, Pittsburgh; W. F. Barker, Boston, Mass.; Ichisuke Fujioka, Tokio, Japan; Mr. Fitzgerald and wife, Duluth; W. B. Banks, Superior, Wis.; Mayor Truelson, O. C. Hartman, C. F. Leland, F. L. Laylor, O. H. Simons, H. E. Smith, Duluth; Mayor Dietrich, Mr. Perrin, A. A. Cross, West Superior; Mr. Scanlon and wife, Milwaukee; W. M. Lowerie, Chicago; W. H. Friend and wife, Vincennes; G. T. Manson, New York; S. C. D. Johns and wife, Cleveland, Ohio; B. J. Arnold and wife, Thos. J. Stacey and wife, Chicago; Jos. Wetzler and wife, New York; J. M. Hill and wife, Mrs. S. D. McDonald, Chicago; H. G. Underwood and wife, Milwaukee; H. Hergett and wife, Pekin, Ill.; H. D. Goodwin and wife, Hugo P. Goodwin, Milwaukee; M. L. Stern, Denver, Colo.; S. Scovil and wife, Cleveland, Ohio; Miss Parker, Evanston; H. C. Maloney, J. J. McDonald, J. J. Schayer, Chicago; H. A. Wagner, St. Louis, Mo.; Mrs. Perry, Chicago; J. Jennings, Wilkinsburg, Pa.; Thomas Ferris, Milwaukee; F. M. Kimball, H. F. Edgar, Boston, Mass.; W. W. Dailey, Max Bass, Wallace O'Connor, Chicago; H. M. Atkinson, Atlanta; E. B. Kittle, F. N. Boyer, Chicago; L. J. Desenberg, W. F. Kingman, Sault Ste. Marie; S. E. Doane; Converse D. Marsh; W. C. Knight, Fort Wayne; W. S. Smith, Toledo; F. N. Phillips, Providence; F. E. Donohoe, Chicago; Mr. Woodbridge, C. W. Price, New York; J. S. Church, Chicago; James R. Dee, Houghton, Mich.; Henry L. Doherty, Madison Wis.; A. D. Page; F. A. Copeland, La Crosse, Wis.; Thomas R. Mercein, Milwaukee.

SUBMARINE TELEGRAPHY.

THE SYSTEM OF THE CENTRAL & SOUTH AMERICAN TELEGRAPH COMPANY.

TO THE EDITOR OF ELECTRICAL REVIEW:

I observe in your issue of ELECTRICAL REVIEW, June 8, an article signed "Electrician," giving a description of the cable lines of the world, in which is stated that the description "has been prepared with much care." This may be entirely correct, but evidently the article was written from an English cable point of view, for it entirely ignores this company's system between Buenos Ayres and Valparaiso, and from Valparaiso, Chili, to Lima, Peru, although it erroneously states "from Buenos Ayres there is a land-line telegraph, belonging to the Transandine Telegraph Company, to Concepcion, near Valparaiso, on the west coast of South America, where it joins the cable of the West Coast of America Telegraph Company to Chorillos in Peru, whence it is extended by a short land-line to Lima, and thence to Callao, where it joins the Central & South American Telegraph Company."

I desire to correct this statement. The Transandine Telegraph line, between Buenos Ayres and Valparaiso, is owned and operated by the Central & South American Telegraph Company. This line connects with its cables at Valparaiso, which extends north to Iquique, thence to Chorillos, thence north as far as Salina Cruz, Mexico, where the cables connect with the company's land-line system across the Isthmus of Tehuantepec, connecting with the Mexican Gulf cable system, at Coatzacoalcos, belonging to the same company.

For your information I enclose a small map showing the system of the Central & South American Telegraph Company and the Mexican Telegraph Company, known together throughout the world as the "via Galveston" route. You will observe the Central & South American Telegraph Company has a duplicate cable line from Chorillos, Peru, to St. Elena, Ecuador; St. Elena to San Juan, Nicaragua; San Juan to Salina Cruz, Mexico; and that the cables in the Gulf of Mexico are also duplicated.

It is true that there is a land-line between Buenos Ayres and Valparaiso, which connects with the West Coast of America Telegraph Company's system at Valparaiso. This land-line is known as the Pacific & European Telegraph Company.

Trusting you will give this space in your next issue.

Very respectfully yours,
JAS. R. BEARD,
Secretary Central & South American Telegraph Company.
New York, June 8.

PERSONAL MENTION.

Mr. Cyrus O. Baker, Jr., of New York city, master of transportation, was elected an honorary member of the National Electric Light Association at the Chicago convention.

George N. Tidd, formerly manager of the Waverly N. Y., Electric Light and Power Company, has been appointed general manager and electrician of the Beacon Light Company of Chester, Pa.

On account of Mr. E. R. Mason, of the Mason Electric Equipment Company, Chicago, being a member of the naval militia of Illinois, and being called into active service, it is requested that, for the present, all orders be sent to the company's St. Louis office, 314 Security Building.

Mr. Kempster B. Miller, who for some years past held the position as expert for the Western Telephone Construction Company and prior to that was engaged in the patent office, has severed his connection with the company, and on July 1 next will take charge of the telephony and telegraphy department of the International Correspondence School, Scranton, Pa. The concern is to be congratulated on securing the services of so able an engineer.

A NOVEL FORM OF THERMO-ELECTRIC BATTERY.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, APRIL 27, 1898, BY C. J. REED.

(*Concluded from page 351*).

In Fig. 13 the conditions were the same as those of Fig. 12, excepting that a silver cup was substituted for the iron cup, and, consequently, there was no iron present in the electrolyte. The marked irregularities in the curve of electro-motive force shown in Fig. 13 are to be expected from the high thermal conductivity of the silver cup and rod, which makes the apparatus very sensitive to fluctuations in the source of heat. The absence of any indication of chemical change or change of color in the electrolyte or of any corresponding absorption of heat or change of electro-motive force is accounted for by the fact that there is no iron or nickel in the solution, and that the dehydration is accomplished without any chemical change due to the presence of impurities.

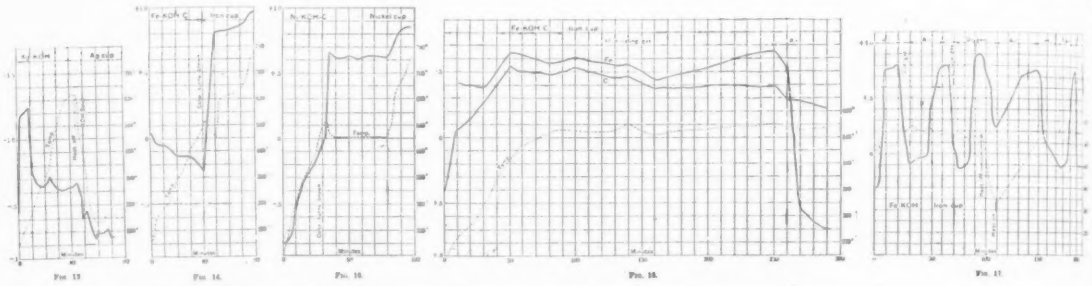
Figs. 14 and 15 show the result of substituting for the normal electrode in Figs. 8 and 6 respectively, rods of iron and nickel. The effect of this change was to remove the arbitrary zero of potential established by the introduction of the normal electrode and to transfer the neutral point, at which the electro-motive force changes sign, to a position within the diagram. The neutral point on these diagrams corresponds to the temperature of 555 degrees ± 5 degrees, coinciding with the temperature at which the chemical change and the absorption of heat occur. These curves are not inverted, but are copied without change from the curves given by Liebenow and Strasser.

In Figs. 16 and 17 the results are further complicated by the use of various disturbing influences. The most important change introduced in these experiments was to close the cup with a practically air-tight cover, through which a carbon and an iron rod were inserted. This entirely prevented the circulation of the air over the surface of the electrolyte and around the lower ends of the rods. The temperature of such a closed chamber above the electrolyte would be only slightly less than that of the electrolyte itself after the apparatus had become thoroughly heated. The lower ends of the carbon and iron rods, being surrounded by an atmosphere nearly as hot as the electrolyte, would have little difference in temperature at their surfaces of contact with the electrolyte, notwithstanding their great difference in conductivity. Such an arrangement would result in a very much lower electro-motive force. Liebenow and Strasser reported no experiments under exactly these conditions, but gave in Figs. 16 and 17 the results obtained by various modifications of these conditions, viz., by passing through the closed chamber various gases.

Unfortunately sufficient attention was not given to the details of these experiments to enable us to decide to what extent, if any, the results were due to the chemical action of the gases introduced, and to what extent they were due to their cooling effect. If the air and all the various gases were passed through the closed chamber at the same temperature and all with the same velocity, the only difference in their cooling effects would be that due to the differences in their specific heats. These could not be very great and would probably be negligible. If, on the other hand, the gases were passed through the cell with greatly varying velocities, their cooling effects, particularly on the iron rod, would be very different.

Fig. 16 shows the result obtained by passing illuminating gas through the cell for four hours and ten minutes, then replacing it by air. At the end of the first hour the temperature and the electro-motive force became practically constant and remained so until the change was made from illuminating gas to air. When this change was made there was a noticeable though not great fall in the temperature of the electrolyte, a corresponding change in the electro-motive force of both the carbon and the iron as compared with the normal electrode, the change in the iron being very great. These curves, which are also the inverted curves of Liebenow and Strasser, are seen to follow the temperature curve in exactly the same manner as the curves of carbon and iron shown in Figs. 5 to 12.

In the absence of any statement to the contrary by Liebenow and Strasser, the inference is reasonable that the air forced through the cell was in a large or unlimited quantity, while the flow of the combustible gases was adjusted to make the issuing jet burn with as small a flame as possible. If such were the case, the cooling effect of the air on the rods could not fail to produce the result shown in Fig. 16. The same explanation applies with equal force to the results shown in Fig. 17, in which various gases were successively passed through the cell. There is no doubt that the results are also complicated by various chemical changes resulting from the gases introduced. The introduction of pure oxygen, for example, in contact with the red-hot carbon would certainly result in a vigorous combustion of the carbon, which would tend to increase its temperature even above that of the electrolyte and augment the effect shown in Fig. 17. But the lack of more detailed information concerning these experiments makes it useless to speculate further.



DIAGRAMS ILLUSTRATING "A NOVEL FORM OF THERMO-ELECTRIC BATTERY."

ELECTRIC LIGHT FLASHES.

The Redlands, Cal., Electric Light and Power Company will increase its capital stock from $200,000 to $500,000.

The Sioux Rapids, Iowa, roller mills and electric light plant were destroyed by fire a few days ago at a loss of $20,000.

The gas and electric light plants of the Pittsburg, Kas., Light and Coke Company have been sold under mortgage to the National Bank of Pittsburg for $40,000.

The contract for lighting the city of Hartford, Ct., has been awarded to the Hartford Electric Light Company, A. C. Dunham, president. The contract is for six years, at $75 a light per year.

The plant of the Peninsular Electric Light Company has been sold to George Peck, David Whitney and Hoyt Post, of Detroit, Mich., for $120,000. The sale was caused by foreclosure proceedings on a mortgage of July 1, 1891.

The electric light plant of the Macon, Ga., Gas Light Company has been sold to the Macon & Indian Spring Railroad Company for the sum of $40,000. No other bidder was present. The property was bought in by J. H. Hertz for the new owners of the plant. The plant will be improved at once, and Macon will have a thorough electric light plant.

Application has been made to Justice Johnson, in Brooklyn, N. Y., for an injunction restraining the Amsterdam Electric Illuminating and Power Company from disposing of the plant and franchise of the State Electric Light Company, of which it has control. Mark Farrell, a stockholder of the State company, is the petitioner. He alleges fraud and mismanagement.

Mr. Ernest H. Davis, general manager of the Lycoming Improvement Company, of Williamsport, Pa., recently purchased a large interest in the Beacon Light Company, of Chester, Pa., which company, through purchase and lease, now controls the entire electric light and power business for Chester city and vicinity. Large extensions to the present plant, which is already one of the finest in the state, are contemplated, and many improvements will be made during the year. Mr. Davis has been elected one of the directors of the company, of which Mr. J. George Kaelber, of Rochester, N. Y., is president. Mr. Kaelber is one of the best known representatives of the Western Electric Company and has a wide acquaintance in electric lighting circles. The experience of both Messrs. Davis and Kaelber in the electric light and power business should prove of great benefit to the Beacon Light Company.

THE TELEPHONE IN WAR.

ITS VALUABLE SERVICES IN HANDLING TROOPS — THE LONG-DISTANCE EQUIPMENT AT CAMP BLACK THE FIRST IN HISTORY.

BY ARTHUR R. PARDINGTON.

The often hinted at, frequently discussed, but never before realized field telephone in actual warfare has come and is come to stay. For the first time in the history of the telephone and in the history of the United States Army, a long-distance telephone has been used for the purposes of handling troops in time of war.

At Camp Black, Hempstead, L. I., the State of New York installed, through the New York & New Jersey Telephone Company, a complete system of field telephones, each connected by a direct line with the central office and operated by a skilled attendant. These telephones were placed in the executive office of the adjutant of each one of the nine regiments, in the office of the chief of staff of the division commander and in the field hospital.

The placing of a telephone in the field hospital proved of exceptional value to the surgeon in command of the medical men of the post. He was able in turn to reach the regimental surgeons direct, and was also able to keep in close touch with the surgeon detailed in charge of the hospital. It was also possible for him in certain cases to arrange for the transfer of patients whose condition was such as to require more extensive treatment in the city hospitals. It allowed the surgeons of the various regiments to be in instant communication with the city, so that their representatives at home felt that they were accessible at all hours.

The use of the telephone in the handling of troops and the issuing of orders, official or otherwise, simplified matters wonderfully, and the delays attendant upon the usual form of dispatching orderlies with communications were reduced to a minimum. Major-General Charles F. Roe, in charge of the division camp at this point, expressed himself as gratified that the telephone had been installed and the system made so comprehensive. The dispatching of troops to the South by orders received from the adjutant-general's office in Albany was greatly facilitated. Immediately upon receipt of orders from Washington, ordering the various regiments to points in the South, the adjutant-general communicated instantly and directly with the commanding officer of the regiment so ordered. At one or two points within the writer's knowledge, where the states had not provided the accommodations afforded by the telephone, the delays were great, and in one or two cases embarrassing. The new commandant of the camp at Hempstead, Major-General Pennington, speaks in the highest terms of the system, saying that he never before in all his army experience had found it so convenient to transact the business of a large camp.

The telephone pay station installed in connection with the system provided ample accommodations for all enlisted men to either transmit or receive messages to and from home, the delays and uncertainties attendant upon the telegraph being entirely overcome. Many of the men, privates and officers, members of the various organizations ordered into camp at Hempstead, were men of large business interests, the details of which they were able to follow by being in direct communication with their business offices from their regimental headquarters.

FIELD TELEPHONING AT CAMP BLACK, HEMPSTEAD, L. I.

At each regiment an orderly was detailed to receive and send messages, to call officers to the telephone for the receiving of messages, or to make appointment calls, which was done in a very large number of cases. The expressions heard from these officers were all highly commendatory, and they greatly appreciated the action of the state in installing the long-distance telephone.

In connection with this, it might be well to add that Camp Black, although the system was very extensive, was not absolutely the first to be connected generally in this manner. At Fort Hancock, Sandy Hook, the government installed a switchboard connected by a direct line with the nearest exchange and in turn connecting some five points on the Hook at which it was most advantageous for telephone service. This, however, was considered and still is considered as a permanent arrangement, not being introduced merely for the immediate handling of troops in time of war. In one or two cases at Camp Black, when the troops had been ordered away and the tents taken down, the telephone instruments were attached temporarily to the nearest distributing pole and messages were sent and received in the open air, giving it the actual appearance of field telephony.

The introduction of this system was thoroughly appreciated by the newspaper correspondents and by the news and editorial staffs of the various daily papers. It was possible for a newspaper representative having a telephone installed in the newspaper headquarters to communicate directly with the various adjutants and learn "what there was new." Several of the metropolitan dailies availed themselves of these facilities.

On Friday, preceding the lining of the troops at this point, which was on Monday, a representative of the telephone company went to Camp Black on a special train with General Roe, took through him a lay-out of the camp as proposed, submitted a proposition to him, and on Monday following, when the troops were in camp, there were installed three trunks working into the Brooklyn central office, three telephone stations, and a mile and three-eighths of pole line had been constructed. By Tuesday night each one of the regimental headquarters, the division headquarters, and the field hospital had been connected, during a total time of about four and a half days, an excellent example of emergency installation.

LITERARY.

The ELECTRICAL REVIEW has received the Transactions of the Academy of Science, of St. Louis, Vol. 8, No. 7, containing "Description of Series Dynamo-Electric Machines" by Carl Kinsley.

The ELECTRICAL REVIEW has received a pamphlet entitled, "The Development of the Central Station," an address delivered at Purdue University, Lafayette, Ind., by Samuel Insull, president of the Chicago Edison Company.

Richard Harding Davis's first two war articles for *Scribner's Magazine* appear in the July number. They are "The First Shot of the War" and "The First Bombardment" (Matanzas), with snapshots of life on the flagship "New York,"—Ensign Boone who fired the first shot to kill, "cleared for action," etc. Mr. Davis will write of the war for no other magazine.

Admiral George Dewey, the hero of Manila, is the subject of a character sketch in the June *Review of Reviews*, by Winston Churchill. This is the only time that the life story of our modest Yankee admiral has been told in print with any completeness. His boyhood days in Vermont, his schooling at Annapolis, and later stirring experiences under Farragut in the Civil War, are all passed in review. Mr. Churchill is himself a graduate of the United States Naval Academy and the author of the very successful novel entitled "The Celebrity." He has had unusual facilities for getting information relative to Admiral Dewey's interesting career and antecedents.

Secretary Long and the Admirals at the Telephone.

[*From the Army and Navy Journal.*]

The Secretary of the Navy presents his compliments to rear admirals communicating with him by long-distance telephone, and would be obliged if they would refrain from damning him when he personally answers the call.

Electrical Review

[OLDEST ELECTRICAL WEEKLY IN THE UNITED STATES.]
TIMES BUILDING, 41 PARK ROW,
P. O. BOX 2339. NEW YORK.

NEW YORK, JUNE 15, 1898.

CHARLES W. PRICE, - - - - - - - EDITOR.
STEPHEN L. COLES, - - ASSOCIATE EDITOR.
STEPHEN H. GODDARD, ADVERTISING MANAGER.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," - - - NEW YORK.
TELEPHONE CALL, 1546 "CORTLANDT."

NEW YORK OFFICE:
RUSSELL HOWLAND, REPRESENTATIVE,
Times Building, 41 Park Row.

WESTERN OFFICE:
CARL E. KAMMEYER, REPRESENTATIVE,
1627 Monadnock Block, CHICAGO.
TELEPHONE, HARRISON, 475.

WASHINGTON OFFICE:
GEO. C. MAYNARD, - REPRESENTATIVE,
800 H Street, N. W., WASHINGTON, D. C.

LONDON OFFICE:
HENRY W. HALL, - - REPRESENTATIVE,
12 Old Broad Street, LONDON, E. C.
News, Subscriptions and Advertisements.

Subscription to the ELECTRICAL REVIEW.

One Year, United States and Canada, - - $3.00
One Year, Foreign Countries, - - - - - 5.00
Single Copies, - - - - - - - - - - .10
Copies can only be supplied for one year back at 25 cents each.

SPECIAL NOTICE TO ADVERTISERS.
CHANGES for advertisements must be in this office by Friday noon for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week.

Views, News and Interviews..... 383
Electric Light Men..... 383
The Northwestern Electrical Association..... 385
Submarine Telegraphy..... 385
Personal Mention..... 385
A Novel Form of Thermo-Electric Battery..... 386
Electric Light Flashes..... 386
The Telephone in War..... 387
Literary..... 387
Secretary Long and the Admirals at the Telephone..... 387
The Electric Light Convention..... 388
Wall Street and the Electrical Stock Market..... 388
Mr. A. M. Young..... 389
Personal..... 389
Important Telephone Litigation in Chicago..... 389
A Decision on the "Reversible Trolley" Patent. 389
Illness of Mr. F. J. Sprague..... 389
New Electrical Headquarters..... 390
Telephone News and Comment..... 391
Convention Notes..... 392
Transformer Regulation..... 394
Edison Battery Fan Motors..... 395
South Jersey Telephone and Telegraph Company..... 395
General Merritt to Marry Miss Williams..... 395
Advance Information..... 396
The British Volunteer Electrical Engineers..... 396
The Underground Trolley in New York City..... 396
Secret Telegraph Sounder Wanted..... 396
General Distribution from Central Stations by Alternating Currents..... 396
The American Stoker..... 397
A Battery Fan Outfit—Knapp Motors and Gordon Cells..... 397
Kindred Interests..... 398
Electrical Patents..... 400
Trade Notes..... 400

Advertisers' Alphabetical and Classified Index on page xii.

The comfort of passengers on the various underground trolley roads of New York city would be greatly increased if the motormen received better instruction with regard to starting the cars. With the type of controller now in use, there is no reason for a car being started with a jerk. This is a relic of the days of cable roads which should be promptly corrected.

THE ELECTRIC LIGHT CONVENTION.

The twenty-first convention of the National Electric Light Association, held at Chicago last week, was well attended, and the papers and discussions of much practical value.

President Insull's opening address touched on the methods which enabled American manufacturers to sell their goods in competition with those made by the low-priced labor of Europe, and said the same methods of economy had enabled the electric lighting companies to better their service and decrease the cost to consumers. The most searching investigation was in constant progress to determine how the cost of the light might further be lowered, and the number of users increased so that each might get its share of the advantages. On the vexed question of public control and private operation of lighting plants, Mr. Insull's opinions were pronounced. He laid down as the true principle that franchises granted public corporations should secure them the same degree of protection in their rights to their property as is enjoyed by other investments, and the public control of charges for service based on cost plus a reasonable profit, eliminating the faction of competition, he said, is the proper safeguard for users, taxpayers and investors.

There were several other notable addresses, particularly those by Messrs. Rice, Dow, Wagner and Ferguson, relating to questions of importance to the operators of electric lighting plants. These papers were discussed with much animation, and the several "topics" on the programme also received close and searching attention from the many wide-awake electrical men present.

There was a satisfied air to be noted among all the delegates and visitors when the convention finally concluded its sessions on Thursday afternoon, and another very successful meeting is to be recorded on the long list now possessed by the National Electric Light Association, which had its birth in Chicago 13 years ago.

A case of importance to electric railway companies has recently been decided at New Orleans by the Circuit Court of Appeals. It seems that some time ago the city of Atlanta, Ga., passed an ordinance to regulate the rate of fare to be charged by the Atlanta Street Railway Company. The trustee for the bondholders of the road brought suit against the city of Atlanta to enjoin it from enforcing the ordinance, claiming that it was unconstitutional. The case was tried in the United States Circuit Court at Atlanta and was decided in favor of the trustee and against the constitutionality of the act. The city took an appeal. The Circuit Court of Appeals at New Orleans has just sustained the decision of the Circuit Court at Atlanta, thereby establishing the fact that a city can not by ordinance regulate the rates of street railway fares so as to interfere with the profitable operation of the road. The injunction ordered is made perpetual. The decision is important, as it outlines to what extent a municipality can regulate the rate of fare charged by street railways.

It is a wonder that no thrifty and long-headed individual has made a move towards getting a projectoscope apparatus on some one of our warships. What a wonderfully effective bit of pictorial history could be produced in a lively tilt between two fleets in the present war! Even if the government would not allow the apparatus on a war-ship, the thing might be done from one of the press-boats, with the superlative advantage of selecting a position out of the line of fire, and thus taking both fleets into the camera. Let some one get his outfit ready for the inevitable bombardment of Havana, and his fortune will be assured.

The First Regiment of Volunteer Engineers is being rapidly recruited and a considerable number of prominent professional men have received commissions. The rank and file of this regiment is composed of unusually intelligent and valuable men, and great things may be expected of them if they see active service.

WALL STREET AND THE ELECTRICAL STOCK MARKET.

The course of the stock market during the latter part of the week was distinctly upward, and showed a disposition on the part of both the public and large speculative interests to resume active operations. Conditions throughout the country are so good generally as to make an era of prosperity this year almost a certainty. Wall Street argues that bull conditions must make a bull market. The belief that the end of the war is near at hand, the continued ease in money and conditions in general all have contributed to create an upward trend to security values.

The electrical stocks have shown a noteworthy increase in activity, with resultant gains in prices. General Electric was the leader, about 35,000 shares changing hands. The quotation advanced from 37⅛ to 39⅜, and higher figures are predicted. Much of this buying has been based upon the belief that the progress making in the plans for correcting the impairment in the capital is satisfactory to the largest interests, and that the business now doing by the company is sufficient to create strong hopes of dividends in the near future.

Western Union was quiet but ruled steady at 91⅜ to 92½. The collateral trust 5's sold at 109¼. The statement, partially estimated, for the quarter ending June 30 shows that the net revenue was $1,750,000, an increase of $240,318 over the corresponding period last year. The balance shows an increase of $220,789. The total surplus is $8,035,942 or an increase of $388,400. The company's fiscal year ends with the June quarter and it may therefore be estimated that the net revenue for the year will amount to $6,162,888, or an increase of $430,685 over the previous year. The estimated balance for the year should amount to $5,256,308, an increase of $459,606. The company this week declared the regular quarterly dividend of 1¼ per cent, payable July 15. The officials of the company state that the quarterly statement would have been even better than it is had it not been for the government censorship, which has materially interfered with press business. The comparison with the same period last year is nevertheless very favorable.

Brooklyn Rapid Transit was one of the features of the market. The Court of Appeals decided favorably to the company in the case of Mr. Hearst against Mr. Shea, and the

right of the trolley to cross the Bridge is established. In addition to this, large increases in earnings are shown daily. The stock rose from 42 on Monday to 53½ on Friday.

North American was active, several thousand shares changing hands at 5⅞ to 6⅜. It is understood that much of this stock represented the Pullman holdings.

Other transactions included Edison Electric of New York 1st 5's at 111½ and consolidated 5's at 117¼; Edison of Brooklyn stock at 106½ and some American Telegraph and Cable at 92⅝ to 93½.

The American Bell Telephone Company has issued $5,000,000 of 4 per cent ten-year debenture bonds, dated July 1, 1898. Of this, $2,000,000 is to refund a like amount of 7 per cent bonds falling due August 1, 1898, and $3,000,000 for the estimated new construction requirements.

The Commercial Cable Company has declared its regular quarterly dividend of 1¾ per cent on the capital stock of the company, payable July 1.

The United Traction and Electric Company has declared a dividend of ¼ per cent on the capital stock, payable to the registered holders on July 1.

At the annual meeting of the Mexican Telegraph Company held on Tuesday, the old board of directors was re-elected.

At the annual meeting of the shareholders of the Central & South American Telegraph Company to day, the old directors were re-elected with the exception of J. P. Morgan, who resigned some time ago. His place was taken by Mr. Francis L. Higginson, of Boston.

Electrical stocks in Boston during the week were very quiet, transactions aggregating a trifle more than 1,000 shares. Quotations, however, fluctuated within a range of from ⅞ to 4½ per cent, the latter in Bell Telephone, which sold down to 271, after opening at 275, recovering subsequently, and closing at 275½. Erie Telephone changed hands between 68½ and 70; New England Telephone sold at 132; Westinghouse, common, at 24, closing 21 bid, offered at 22, and the preferred ranging between 54⅛ and 55, the latter being the closing price.

In Philadelphia, Electric Storage Battery opened at 23, advanced ¼, sold down to 22, closing at 22½. The preferred was quiet at 25¼ to 25½. Pennsylvania Manufacturing, Light and Power opened at 13½, advancing and closing at 14⅞.

It is understood that the contract for the great generator for the Boston Elevated Railway has been secured by the Walker Company. RAY.

Wall Street, June 11.

MR. A. M. YOUNG.

THE NEW PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Mr. A. M. Young, of Waterbury, Ct., who has just been elected president of the National Electric Light Association, like many another famous man began his career in electricity as a telegraph operator, at Fort Plains, N. Y., in 1870. He was transferred, from time to time, to Saratoga, Syracuse, Albany, Buffalo and New York city. In March, 1878, Mr. Young assumed the management of the Waterbury Automatic Signal Telegraph Company, which was a company organized in Waterbury, Ct., for operating the Watkins system of automatic fire-alarm and telephone system. In 1883 this company was amalgamated with the Connecticut Telephone Company, of New Haven. Mr. Young continued in the management of the telephone business for that section of the state until 1888. In 1883 he organized the Connecticut Electric Company, which built an electric light plant at Waterbury, using the Thomson-Houston system of arc lighting and the Edison system of incandescent lighting. Since that time Mr. Young has been interested in the successful organization of a large number of electric light and power plants in various parts of the country. In August, 1890, the New England Engineering Company, of Waterbury, Ct., was formed, and Mr. Young was made its president. Within a few months Mr. Young and a number of prominent capitalists organized the Kings County Electric Light and Power Company, of Brooklyn, N. Y. This company is now completing a central station of the most approved and modern type. Mr. Young has always been actively connected with the National Electric Light Association, and last year served as its first vice-president.

PERSONAL.

Dr. Allan V. Garratt, chief engineer of the Lombard Water-Wheel Governor Company, of Boston, visited New York city last week.

The Senate has confirmed the appointment of Dr. Louis Duncan, of Baltimore, as a major of the First Regiment of Volunteer Engineers.

Mr. Hunt Chipley, of Norfolk, Va., has been appointed superintendent of the Southern Bell Telephone Company, vice Col. C. E. McCluer, resigned.

IMPORTANT TELEPHONE LITIGATION IN CHICAGO.

WESTERN ELECTRIC COMPANY SUES THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY AND MILO G. KELLOGG.

The first step of what promises to be a fierce conflict between the American Bell Telephone Company and certain independent interests was taken on June 9, when the Western Electric Company, by its attorneys, Messrs. Barton & Brown, filed a bill in the United States Circuit Court at Chicago asking that the Kellogg Switchboard and Supply Company be enjoined from infringing the now famous Firman patent No. 252,576, of January 17, 1882. The Kellogg company was organized some two years ago for the purpose of building telephone switchboards and other telephone appliances under the numerous patents of Milo G. Kellogg. It is said that the first order received by the company was one from the Kinloch Telephone Company, St. Louis, for a switchboard of 5,000 lines' capacity and the factory of the Kellogg company has been building this board ever since, the intention being to open the St. Louis exchange some time this Summer.

The Western Electric Company claims, in its bill, that in building this board the defendant is infringing the patent, and asks that an injunction issue. The patent expires next January, and it would seem that in view of this fact alone a court would hesitate to enjoin the defendants without most positive proof that the board is intended to be put in actual service before the expiration of the patent.

The outcome of the suit, whatever it may be, will greatly affect the independent interests, because, should the injunction be denied, it will at once give other manufacturers the courage to put multiple boards on the market without waiting for the expiration of the patent.

A Decision on the "Reversible Trolley" Patent.

An opinion was filed on Saturday, June 11, by Judge Shipman in the United States Circuit Court for the Southern District of New York in the case of Thomson-Houston Electric Company vs. Union Railway Company and Walker Company. The bill of complaint in that case was based on letters patent No. 495,383, dated April 11, 1893, to Charles J. Van Depoele. Three claims of this patent (11, 12 and 13) were involved. This patent is known as the "reversible trolley" patent, and was claimed by complainants to be the foundation patent in the art of trolley traction for reversibility of the trolley. Besides the quality of reversibility, complainants claimed that this patent was the first to show a trolley which presented a wide and unrestricted lateral movement of the trailing-arm as well as reversibility. The defenses to the suit were non-patentability of subject matter and public use at New Orleans for more than two years prior to the application for the patent. Although the patent had previously been adjudicated in the Winchester avenue case and held invalid, it was claimed that, in the Winchester avenue case, it was overshadowed by the main trolley patent, No. 495,443, and that the fuller record of this case established complainants' claims to the validity of the patent. Judge Shipman, in his opinion, makes an independent examination of the subject as if it was not controlled by the former adjudication, and holds with Judge Townsend that the patent is invalid for lack of patentability, it being a matter clearly within the ingenuity of the mechanic skilled in the art to make the original Van Depoele underrunning trolley freely rotatable and reversible in view of devices in the art long antedating Van Depoele. The bill was dismissed with costs. Betts, Betts, Sheffield & Betts appeared for the complainants and Mitchell, Bartlett & Brownell for the defendants.

Illness of Mr. F. J. Sprague.

It will be of interest to the general public, hardly less than to the electrical fraternity, to know that Lieut. Frank J. Sprague, who has for the last six weeks been confined to his house, and in great suffering, from a severe injury to his right eye, is in a fair way to recovery. Nearly two months ago a piece of the eyeglass Mr. Sprague was wearing was accidentally forced into the ball of the eye, and Mr. Sprague had to remain for some two weeks under the care of a specialist. Being very anxious to push forward to definite shape the Volunteer Corps of Electrical Engineers, which he offered some time ago to organize for early service at the front, Mr. Sprague imprudently went to Washington, where he caught cold in the injured eye. Severe complications set in, along with iritis, and for some time it was feared that blindness was inevitable. This danger, however, seems to have passed, and there is every prospect that Mr. Sprague will soon be able to renew his active part both in the affairs of the company with which he is identified, and the formation of a fighting corps that should fill a place of its own in the war resources of the government.

NEW ELECTRICAL HEADQUARTERS.

THE CENTRAL ELECTRIC COMPANY, CHICAGO, REMOVES INTO A LARGER AND MORE COMMODIOUS BUILDING—A HIGHLY SUCCESSFUL ELECTRICAL HOUSE.

Possibly a wider difference does not exist than that between Fifth avenue in New York and Fifth avenue in Chicago. One lined with palatial residences, the index of all that represents wealth, refinement and luxurious ease; the other a busy thoroughfare, flanked by massive business blocks, traversed by lines of street and elevated roads, and covered with a surging crowd of traffic—teams, delivery wagons, messengers and pedestrians generally, whose sole aim and purpose seem centered in the word business. As its eastern namesake has long been the home of the merchant princes, Fifth avenue in Chicago bids fair to become the center of the more prominent wholesale business, whose energy and continued growth has contributed so greatly towards making Chicago the city it is to-day. It may have been this idea that prompted President Geo. A. McKinlock, of the Central Electric Company, to select Fifth avenue as the new location of what is undoubtedly one of the best appointed and most systematically arranged, and probably the largest exclusively electrical supply house in the United States. The building is located between Jackson boulevard and Van Buren street, including Nos. 264 to 270 on Fifth avenue. The building is of modern construction, but was remodeled and especially arranged for the requirements of its new tenant. Great credit is due to the company's foresight and executive ability in so planning the transferring of the large stock of supplies and changing of fixtures that not a moment's interruption was caused in filling the volume of daily orders with the company's proverbial promptness.

FIG. 1.—"WHERE COUNTERS, BINS AND SHELVING EXTEND FROM WALL TO WALL."

Looking along Fifth avenue the large Okonite sign, inseparably associated with the Central Electric Company, easily directs a visitor to the new store.

Passing through the main entrance, the visitor finds himself in the retail and house-goods department, where counters, bins and shelving extend from wall to wall. Here the electrical purchaser can find, properly arranged and easily accessible, everything that can possibly be called for in the way of electrical material, supplies or smaller apparatus. Various tables and platforms, suitably arranged and displayed, contain samples of motors, transformers and other apparatus, while handsome panels and wall-cases show, artistically mounted, the many styles of switches, tools, testing instruments, etc.

This department is in charge of Mr. F. M. Pierce, one of the veterans in the supply business, whose wide acquaintance among the trade is of great value to him in efficiently catering to the demands of the company's patrons.

Turning to the left, we pass along the executive offices, accounting and general sales department, to which has been assigned the entire first floor front, so as to secure an abundance of daylight, and also to facilitate the handling of the business.

The private offices are occupied in the order named by Chas. E. Brown, secretary; Geo. A. McKinlock, president, and S. R. Frazier, treasurer, with a commodious office intervening between the president's and secretary's office for the accommodation of the stenographic force. Returning toward the front of the store is passed the open offices of chief order clerk T. D. Lempke; general salesman and advertising manager Chas. G. Burton, and those of Messrs. J. M. Knox and H. T. Conly, special and city salesmen.

The proper and most efficient arrangement of a stock-room has always been a problem to vex and worry the average stock or shipping-clerk. In the stock department, located to the left of the retail store and occupying the balance of space across the building, can be seen an example of the system necessary to expeditiously handle the enormous variety of material that can be classed under the head of electrical supplies. While the system may seem complex at first sight, it is in reality simplicity itself, and its success depends upon a strict adherence to the old axiom "everything in its place." Extending from wall to wall, and built in tiers from floor to ceiling, with intermediate platforms to facilitate handling, are arranged bins upon bins—bins until the eye grows weary, and we ask: "How many bins?" Well, placed end to end they would make a line not very much short of a mile, and when we find 120 of them assigned to Okonite products alone, we begin to conceive the extent of the stock carried. There are switches and cut-outs, sockets and lamps, insulators and porcelain goods, carbons and brushes, cords and cables, staples and cleats, and everything else electrical, except the heavier stock, which of course is carried in the basement, spacious and well lighted by means of luxfer prisms, and where a carload or two of wire or insulators take but a fraction of the space, in which 35 carloads of material would find ample room.

Glancing into the shipping-room, we find it extending across the entire rear of the building, facing the alley, where conveniently arranged loading and shipping platforms are lined with teams ready to distribute the shipments among the several freight depots, all of which are located within convenient hauling distance from the store. While the room seems extra large, none too much space is used for the expeditious handling and packing of the goods.

The members composing the Central Electric Company are so widely and favorably known to the electrical trade that any extended mention is unnecessary. President Geo. A. McKinlock, to whose business sagacity and keen foresight the present enviable standing of the company is due, has been identified with it from its inception, and, aided by secretary Chas. E. Brown, whose capacity for hard work and command of the business details is unrivalled, as well as by the sound financial judgment and experience of treasurer S. R. Frazier, will undoubtedly succeed in bringing to a still higher state of prosperity the company he has so ably guided heretofore.

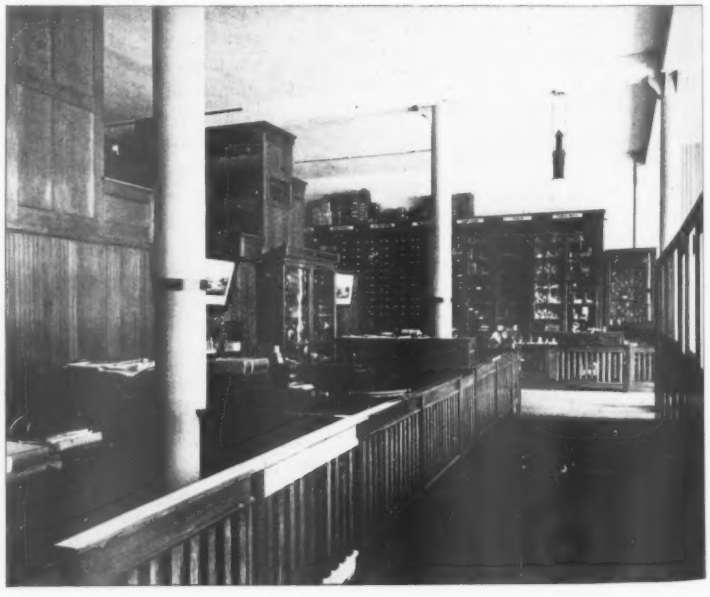


FIG. 2.—"TURNING TO THE LEFT."

TELEPHONE NEWS AND COMMENT.

The Pennsylvania Electric Company, of Marietta, Pa., has received an order from the government for 15,000 telephones for use in lighthouses and signal stations.

The New England Telephone Company, of Boston, has filed a petition with the town clerk for telephone connection with Greenfield, and the work of setting poles will commence at once.

Josiah Holbrook, representing the National Telephone Company, of Chicago, proposes to install an independent telephone system at Evansville, Ind., the rates to be $2 for business houses and $1.50 for residences.

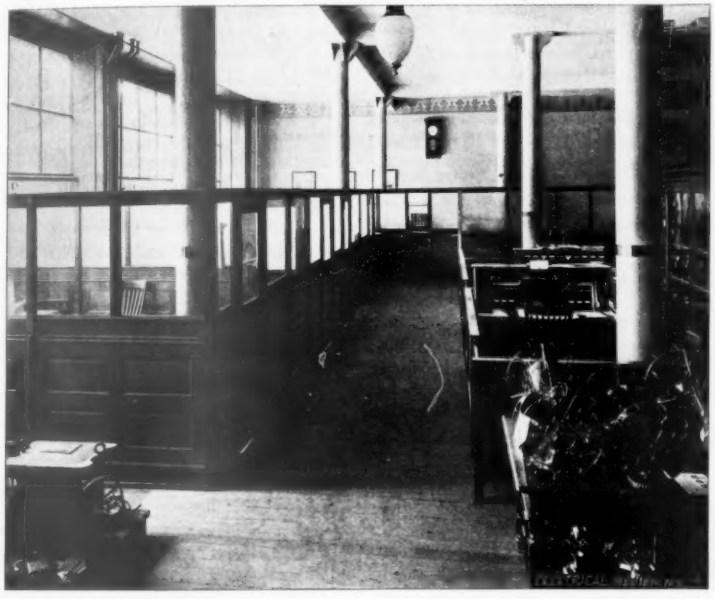


FIG. 3.—"WE PASS THE OPEN OFFICES."

The New York Telephone Company will erect a new exchange at 112 West Eighty-ninth street, New York city. The building will cost about $50,000. The new exchange is intended to serve a section of the west side now connected with the Columbus and Harlem exchanges.

The instrument statement of the American Bell Telephone Company for the month ended May 20, is as follows:

	1898.	1897.	1896.
Gross output	32,441	20,598	20,001
Returned	11,948	8,452	7,537
Net output	20,493	12,146	12,464
Since December 20:			
Gross output	142,362	94,333	96,519
Returned	63,645	36,608	35,999
Net output	78,717	57,725	60,520
Total outstanding	997,898	831,574	737,056

In compliance with the order of Gen. A. W. Greeley, in charge of all strategic control of telegraph and cable lines, the Western Union and Postal Telegraph companies, of St. Louis, have issued orders to their patrons that in the future messages in cipher to any place from which it could be transmitted to Spanish officials will not be accepted by them.

It is reported by the officers of the American Telephone and Telegraph Company that they will, in a short time, connect Birmingham, Ala., with the principal cities of the country by means of the long-distance telephone. Connections will be made reaching from Omaha, Neb., to Augusta, Me., and from the Canadian line to the Gulf of Mexico, including all of the principal cities in that great territory.

The Hudson River Telephone Company has announced that hereafter there will be a night rate for communications between the hours of 6 P. M. and 6 A. M. of one-half the day rate. The night rate will in no case be less than 15 cents, except where the day rate is 10 cents, in which case the night rate will be the same. This applies only to messages between points in the territory of this company.

The directors of the American Bell Telephone Company have voted to issue $5,000,000 four per cent 10-year debenture bonds, dated July 1, 1898. The company has requested bids from various local banking interests. Payments for the $5,000,000 must be made: $2,000,000 on July 1 and the balance on July 29. Of the above issue $2,000,000 is to refund a like amount of seven per cent bonds falling due August 1, 1898, and $3,000,000 is the estimated new construction requirements.

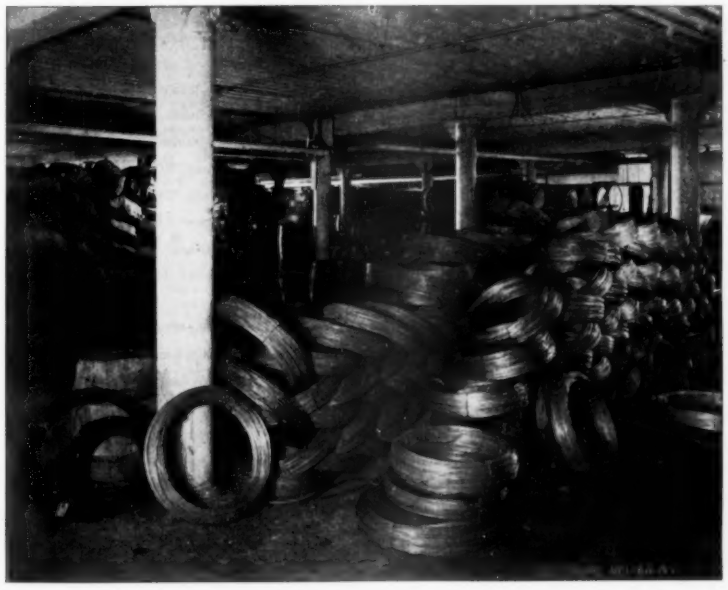


FIG. 4.—"A CARLOAD OR TWO OF WIRE."

The New York & Pennsylvania Telephone and Telegraph Company has recently completed the construction of a new telephone building for its exclusive use at Jamestown, N. Y. The building is three stories in height, 74 by 20 feet, and is in the Colonial style of architecture. It is fireproof throughout. The operating-room is on the third floor, and contains a metallic switchboard with a capacity of 400 drops. The individual call system has been installed on party wires. Nine operators are employed during the day in the operating-room. The general manager of the company is Mr. W. N. Eastabrook, of Elmira, N. Y., upon whom devolves the supervision of the entire company. The superintendent of the western division, which includes Jamestown and Chautauqua County, is J. W. Stearns, who is a pioneer in the telephone business. Mr. A. L. Piper is the manager of the local exchange, which is a credit to all concerned with its construction.

FIG. 5.—"GLANCING INTO THE SHIPPING ROOM."

ELECTRIC LIGHT MEN.

(*Continued from page 384.*)

Edw. L. Barr, W. R. Brixey, Chicago, Ill.
J. H. Shay, Chicago, Ill.
F. H. Badger, Jr., Montmorency Electric Power Co., Quebec, Canada.
Samuel Insull, Chicago Edison Co., Chicago, Ill.
C. W. Rice, Kings County Electric Light and Power Co., Brooklyn, N. Y.
E. E. Wade, El Paso Electric Co., Colorado Springs, Colo.
M. L. Stern, Denver Consolidated Electric Co. Denver, Colo.
Wm. S. Hine, Stanley Electric Manufacturing Co , Chicago, Ill.
Geo. B. Foster, Walker Co., Chicago, Ill.
J. W. Cunningham, Capital Electric Light, Motor and Gas Co., Boise City, Idaho.
J. R. Wiley, Standard Underground Cable Co., Chicago, Ill.
C. O. Baker, Jr., Baker & Co., New York.
Louis A. Ferguson, Chicago Edison Co., Chicago, Ill.
John J. Schayer, Commonwealth Electric Co., Chicago, Ill.
Jno. Jay Abbott, Chicago Edison Co., Chicago, Ill.
Frank H. Clark, Electric Storage Battery Co., Chicago, Ill.
Geo. S. Whyte, Fescher-Macomber-Whyte Co., Chicago, Ill.
L. K. Comstock, Western Electric Co., Chicago, Ill.
S. F. B. Morse, Chicago, Ill.
T. Ellwood Smith, Somerville Electric Light Co., Boston, Mass.
Fred M. Kimball, General Electric Co., Boston, Mass.
Percy A. Clisdell, General Electric Co., Minneapolis, Minn.
James Ferguson, Municipal Electric Light Co., Brooklyn, N. Y.
M. E. Baird, Eddy Electric Manufacturing Co., Windsor, Ct.
G. A. Edward Kohler, Kohler Bros., Chicago, Ill.
I. Fujioka, Japan Electric Light Association, Tokio, Japan.
E. A. Leslie, Manhattan Electric Light Co., Ltd., New York.
F. N. Phillips, American Electrical Works, Providence, R. I.
H. T. Edgar, Jandus Electric Co., of Cleveland, Ohio.
Edward R. Grier, Bryant Electric Co., Chicago, Ill.
S. Marsh Young, Manhattan General Construction Co., New York.
J. McGhie, General Electric Co., New York.
Dr. Wm. Habirshaw, India Rubber and Gutta Percha Insulating Co., New York.
Jas. I. Ayer, American Electric Heating Corporation, Boston, Mass.
W. S. Smith, Toledo Consolidated Electric Co., Toledo, Ohio.
Geo. B. Neal, Charlestown Gas and Electric Co., Boston, Mass.
Henry H. Cutter, Cutter Electric and Manufacturing Co., Philadelphia, Pa., and Mrs. H. B. Cutter.
Maurice Coster, Westinghouse Electric and Manufacturing Co., Chicago, Ill.
Geo. D. Rosenthal, General Electric Co., St. Louis, Mo.
M. B. Kitt, Sprague Electric Co., Chicago, Ill.
E. B. Kittle, Sprague Electric Co., Chicago, Ill.
R. F. Carr and Chas. M. Eddy, Dearborn Drug and Chemical Works, Chicago, Ill.
S. F. Dibble, General Electric Co., Chicago, Ill.
Walter E. Harrington, Camden and Suburban Railway Company, Camden, N. J., and Mrs. Walter E. Harrington.
T. E. Crossman, New York, Official Stenographer.
Thos. R. Mercein, Secretary Northwestern Electric Association, Milwaukee, Wis.
W. L. Arnold, Siemens & Halske Electric Company, Chicago, Ill.
A. Bement, Bement & Co., Chicago, Ill.
R. S. Kelsch, Lachine Rapids Hydraulic and Land Co., Montreal, Canada.
C. J. Field, Standard Fire Proofing Co., New York.
T. Julian McGill, Westinghouse Electric and Manufacturing Co., Chicago, Ill.
C. J. Field, Port Jervis Electric Railway and Light Co., New York.
George F. Porter, Kerite Co., New York.
Chas. B. Obermeyer, Electric Appliance Co., Chicago, Ill.
W. D. Packard, New York & Ohio Co., Warren, Ohio.
W. J. Ferris, General Electric Co., Chicago, Ill.
Chas. D. Shain, Weston Electrical Instrument Co., New York.
H. M. Atkinson, Georgia Electric Light Company, Atlanta, Ga.
Robt. W. Francis, Chicago Edison Co., Chicago, Ill.
W. L. Abbott, Chicago Edison Co., Chicago, Ill.
Thos. H. Ferris, General Electric Co., Milwaukee, Wis.
A. J. De Camp, Brush Electric Light Co., Philadelphia, Pa.
C. L. Leibrock, Chicago Edison Co., Chicago, Ill.
A. W. Field, Columbus Edison Electric Co., Columbus, Ohio.
R. D. Allen, Siemens & Halske Electric Co., Chicago, Ill.
C. J. Wells, Electric Appliance Co , Chicago, Ill.
B. B. Downs, Electric Appliance Co., Minneapolis, Minn.
W. M. Brooke, Electric Appliance Co., New Orleans, La.
J. M. Hollister, Western Electric Co., Chicago, Ill.
R. F. Schuchardt, Meysenberg & Badt, Chicago, Ill.
W. E. Pimlott, Sargent & Lundy, Chicago, Ill.
Geo. Tailleur, Chicago Edison Co., Chicago, Ill.
W. E. Finney, Chicago Edison Co., Chicago, Ill.
Wm. M. Smith, Chicago Insulated Wire Co., Chicago, Ill.
J. M. Knox, Central Electric Co., Chicago, Ill.
C. D. Wilkinson, Western Electric Co., Chicago, Ill.
Edward M. Hagan, Southwark Foundry and Machine Co., Chicago, Ill.
F. N. Boyer, General Electric Co., Chicago, Ill.
H. H. Crowell, General Electric Co., Syracuse, N. Y.
N. Marshall, Anchor Electric Co., Boston, Mass.
W. G. Carlton, Chicago Edison Co., Chicago, Ill.
H. D. Babbitt, Chicago Edison Co , Chicago, Ill.
Thos. G. Grier, Western Electric Co., Chicago, Ill.
G. H. Atkins, General Electric Co., Chicago, Ill.
Chas. Messer, Dearborn Electric Co., Chicago, Ill.
J. H. Cooke, Buckeye Electric Co., Chicago, Ill.
Geo. L. Thayer, Belle Plaine Electric Light Co., Belle Plaine, Iowa.
Jacob Frank, Cosmopolitan Electric Co., Chicago, Ill.
J. M. Atkinson, J. M. Atkinson & Co., Chicago, Ill.
J. H. Goehst, Chicago Edison Co , Chicago, Ill.
H. Cheney, Chicago Edison Co., Chicago, Ill.
W. McLea Walbank, Lachine Rapids Hydraulic and Land Co., Montreal, Canada.
A. M. Barron, Home Electric Light and Power Co., Elkhart, Ind.
Samuel N. Trump, Wilmington City Electric Co., Wilmington, Del.
C. R. Van Trump, Wilmington City Electric Co., Wilmington, Del.
G. Wilbur Hubley, Louisville Electric Light Co., Louisville, Ky.
P. H. Korst, Badger Electric Co., Ltd., Racine, Wis.
J. H. Miller, Springfield Electric Light and Power Co., Springfield, Ohio.
John J. Jennings, Wilkinsburg Electric Co., Wilkinsburg, Pa.
J. S. Crider, The Washington Carbon Co., Pittsburgh, Pa.
E. A. Armstrong, Camden Lighting and Heating Co., Camden, N. J.
J. J. Burleigh, Atlantic Electric Light and Power Co., Camden, N. J.
Chas. B. Hunt, London Electric Co., London, Ont.
Geo. A. Redman, Brush Electric Light Co., Rochester, N. Y., and Mrs. Redman.
Herbert A. Wagner, Missouri-Edison Electric Co., St. Louis, Mo.
J. P. Doan, Jacksonville Gaslight and Coke Co., Jacksonville, Ill.
J. H. Ely, Georgia Electric Light Co., Atlanta, Ga.
Peter Wright, Virginia Electric Co., Norfolk, Va.
T. P. Keck, Brush Electric Light Co., Savannah, Ga.
Geo. T. Jackson, National Conduit and Cable Co., New York.
Jas. P. McQuaide, National Conduit and Cable Co., New York.
A. M. Miller, Red Oak Electric Co., Red Oak, Iowa.
J. M. Bradley, Birmingham Consolidated Electric Co., Birmingham, Ala.
J. C. Shainwald, The Standard Paint Co., Chicago, Ill.
G. O. Rockwood, The Rockwood Manufacturing Co., Indianapolis, Ind.
D. P. Robinson, Edison Electric Illuminating Co., Baltimore, Md.
R. H. Fraser, Des Moines Electric Light Co., Des Moines, Iowa.
H. S. Smith, Sawyer-Man Electric Co., Pittsburgh, Pa.
T. H. Credely, Chicago Edison Co., Chicago, Ill.
Alex Dow, Mutual Electric Light Co., Detroit, Mich.
Geo. W. Cate, Edison Illuminating Co., Detroit, Mich.
W. T. Engel, Charlotte Electric Co., Charlotte, N. C.
H. F. Coggshall, Fitchburg Gas and Electric Light Co., Fitchburg, Mass.
James G. Lowell, Bay County Electric Co., Bay City, Mich.
J. J. Thorne, Electric Engineering Co., Bay City, Mich.
W. F. Hold, Chicago General Fixture Co., Chicago, Ill.
Jas. E. Pyle, Edison Electric Illuminating Co., West Chester, Pa.
J. R. Prentiss, General Electric Co., Philadelphia, Pa.
A. W. Watriss, Chas. A. Schieren & Co., Chicago, Ill.
Robert E. Wyant, Derby Gas Co., Derby, Ct.
C. E. Woodrow, Sioux City, Iowa.
J. G. Fakes, Oklahoma City, O. T.
W. Worth Bean, Jr., St. Joseph & Benton Harbor Electric Railway and Light Company, St. Joseph, Mich.
J. Appleton, Electric Storage Battery Co., Philadelphia, Pa.
Herbert Lloyd, Electric Storage Battery Co., Philadelphia, Pa.
A. M. Robertson, Minneapolis General Electric Co., Minneapolis, Minn.
H. J. Gille, Edison Electric Light and Power Co., St. Paul, Minn.
Edwin R. Weeks, Kansas City Electric Light Co., Kansas City, Mo.
Arthur Warren and Frank H. Taylor, Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa.
Ronald Crawford, Stamford Gas and Electric Co., Stamford, Ct.
J. B. Crouse, Crouse-Tremaine Carbon Co., Fostoria, Ohio.
C. R. Smith, Manhattan Light, Heat and Power Co., St. Paul, Minn.
Ernest H. Davis, Lycoming Electric Co., Williamsport, Pa.
Chas. A. Pratt, Chicago, Ill.
F. D. Hart, Jr., Pineville Electric Light Co., Chicago, Ill.
G. S. Bowen, Elgin, Ill.
Luther Stieringer, New York, N. Y.
Channing T. Gage, Washburn & Moen Manufacturing Co., St. Paul, Minn.
John R. Williams, The Electric Storage Battery Co., Philadelphia, Pa.
S. C. D. Johns, Cleveland Electric Illuminating Co., Cleveland, Ohio.
John Svenson, Bullock Manufacturing Co., Chicago, Ill.
E. W. Clark, Evanston, Ill.
E. P. Young, Sewickley, Pa.
J. W. Uptegraff, Sewickley Electric Co., Sewickley, Pa.
Jas. F. Cummings, Armorite Interior Conduit Co., Pittsburgh, Pa.
C. G. Perkins, Perkins Switch Manufacturing Co., Hartford, Ct.
J. Scribner, General Electric Co., Chicago, Ill.
W. R. Pritchard, Westinghouse Co., Chicago, Ill.
B. F. Harris, Jr., Urbana & Champaign Railway, Gas and Electric Co., Champaign, Ill.
C. A. Benton, Sprague Electric Co., New York.
C. A. Ross, Sawyer-Man Electric Co., Chicago, Ill.
Edw. H. Johnson, Sprague Electric Co., New York.
H. R. Hixson, Simplex Electrical Co., Chicago, Ill.
J. W. Reeves, Johnstown Electric Light Co., Johnstown, Pa.
Charles R. Price and Geo. R. Stetson, New Bedford Gas and Electric Light Co., New Bedford, Mass.
G. E. Wendle, Lycoming Electric Co., Williamsport, Pa.
P. Dull, Milledgeville, Ill.
J. B. Morrill, Evanston Electric Illuminating Co., Evanston, Ill.
A. L. Daniels, The H. B. Camp Co , North East, Pa.
Geo. Cutter, Chicago, Ill.
C. G. Comstock, Thos. Holl and H. S. Wells, Smith Hill Elevator Co., Quincy, Ill.
H. G. Torbert, Dubuque Light and Traction Co., Dubuque, Iowa.
Wm. S. Mold, Star Electric Co., Dubuque, Iowa.
J. W. Ebert, Western Electric Co., Chicago, Ill.
E. H. Abadie, W. A. Layman, S. E. Johanneson and Edwin Pillsbury, Wagner Electric Manufacturing Co., St. Louis, Mo.
F. D. Hart, Jr., Pineville Electric Light Co., Pineville, Ky.
J. R. Cravath, Chicago, Ill.
Frederick S. Pratt, Cumberland Electric Light and Power Co., Nashville, Tenn.
John Young, Western Electric Co., Chicago, Ill.
J. Frank Andres, Belleville Gaslight and Power Co., Belleville, Ill.
A. D. Page, General Electric Co., Newark, N. J.
Hal C. Kimbrough, Muncie Electric Light Co., Muncie, Ill.
W. J. Hanley, General Electric Co., Cincinnati, Ohio.
H. B. Morgan, Jewell Belting Co., Chicago, Ill.
A. J. Blum, American Carbon Co., Fremont, Ohio.
Geo. H. Jones, Chicago Edison Co., Chicago, Ill.
F. E. Smith, Lynn & Boston Street Railroad Co., Boston, Mass.
F. E. Barker, Massachusetts Gas and Electric Light Commission, Boston, Mass.
Jos. D. Lockwood, Michigan Electric Co., Detroit, Mich.
A. W. Hutchins and L. W. Downes, D. & W. Fuse Co., Providence, R. I.
H. S. Anderson, United Electric Light Co., Springfield, Mass.
D. F. Urquhart, T. H. Carbon Co., Boston, Mass.
F. C. Armstrong, Dick Kerr & Co., Toronto, Canada.
C. C. Perry, Indianapolis Light and Power Co., Indianapolis, Ind.
A. C. Yates, Newton, Iowa.
F. A. Copeland and C. H. Greenwood, Edison Light and Power Co., La Crosse, Wis.
G. A. Scheeffer, Diamond Electric Co., Peoria, Ill.
G. G. Luthy, Royal Electric Co., Peoria, Ill.
Geo. T. Manson, Okonite Co., New York.
E. V. Matlock, Laclede Power Co., St. Louis, Mo.
W. M. Hubbard, The Bradford Belting Co., Cincinnati, Ohio.
W. P. Hays, General Electric Co., Cincinnati, Ohio.
W. W. S. Butler, Milton Electric Light and Power Co., Milton, Pa.
James C. Reber, Dayton Electric Light Co., Dayton, Ohio.
Willard L. Candee, Okonite Co., New York.
L. H. Rogers, Ft. Wayne Lamp Co., Cleveland, Ohio.
W. S. Andrews, General Electric Co., Schenectady, N. Y.
E. Ward Wilkins, Partrick, Carter & Wilkins, Philadelphia, Pa.
E. M. Rose, Farmington Electric Light Co., Farmington, Ill.
Eugene Holcomb, Holcomb & Green Electric Co., Springfield, Ill.
J. B. Lukes, United States Electric Lighting Co., Washington, D. C.
F. A. Brooks, Charleston T.-H. Electric Co., Charleston.
J. W. Hull, The Cabinet Manufacturing Co., Steubenville, Ohio.
Elmer Woodling, Logansport, Ind.
A. V. Dee, Philadelphia, Pa.
A. C. Garrison, The Columbia Incandescent Lamp Co., St. Louis, Mo.
Converse D. Marsh, Bryan-Marsh Co., New York.
Geo. W. Conover, Chicago, Ill.
Jas. R. Dee, Peninsula Electric Light and Power Co., Houghton, Mich.
Harry H. Cutler, The Cutler-Hammer Manufacturing Co., Chicago, Ill.
C. F. Drake, Fort Scott Electric Light and Power Co., Fort Scott, Kas.
Elmer W. Gilmer, The Warren Electric and Specialty Co., Warren, Ohio.
John M. Gregory, City Electric Light Co., Bellefontaine, Ohio.
A. F. Webb, American Carbon Co., Noblesville, Ind.
S. S. Frank, Western Electric Co., Chicago, Ill.
H. O. Channon, Quincy, Ill.
Theodore Graham Lewis, Chicago Edison Co., Chicago, Ill.
Alexander Jay Wurts, Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa.
Wm. D. Ray, The Johnson Co., Chicago, Ill.
Chas. E. Roehl, St. Joseph Railway, Light, Heat and Power Co., St. Joseph, Mo.
W. P. Upham, Central Electric Co., Chicago, Ill.
H. E. Webb, Solar Carbon and Manufacturing Co., Pittsburgh, Pa.
F. B. Badt, Chicago, Ill.
H. L. J. Towner, Electric Appliance Co., Chicago, Ill.
A. M. Morse, Atlas Engine Works, Chicago, Ill.
Douglas Hapeman, Thomas Electric Light, Heat and Power Co., Ottawa, Ill.
E. P. Norcross, Janesville, Wis.
L. H. Gilbert, Jonesville Electric Light and Power Co., Jonesville, Mich.
Thos. Cooper, Pekin Electric Light and Power Co., Pekin, Ill.
H. H. Humphrey, Bryan & Humphrey, St. Louis, Mo.
W. F. Kingan, Edison Sault Electric Co., Sault Ste. Marie, Mich.
Chester D. Crandall, Col. Geo. L. Beetle and A. L. Tucker, Western Electric Co., Chicago, Ill.
Geo A. McKinlock, C. E. Brown and Chas. G. Burton, Central Electric Co., Chicago, Ill.
John H. Reid, Westinghouse Glass Works, Pittsburgh, Pa.
Charles R. Huntley, Buffalo General Electric Co., Buffalo, N. Y.
J. H. Culver, Culver Electric Co., Decatur, Ill.
W. H. Tompkins, City Electric Lighting Plant, Niles, Mich.
E. Dysterud, City Electric Lighting Plant, Monterey, Mexico.
Geo. Long, Chicago, Ill.
G. E. Varney, Indianapolis, Ind.
J. F. Connor, M. E. Patterson, Thos. S. Gordon, Chicago, Ill.
John Mustard, Wagner Electric Manufacturing Co , Philadelphia, Pa.
O. Mitchell, Muncie, Ind.
C. Boettcher, E. S. Brinckman, Imperial Electric Light Co., St. Louis, Mo.
Gerald Mahony, Lakon Co., Elkhart, Ind.
Chas. H. Trego, Hoopeston Electric Co., Hoopeston, Ill.
R. S. Stearnes, Ft. Wayne Electric Corporation, New Orleans, La.
E. E. R. Tratman, *Engineering News*, Chicago, Ill.
Harry J. Frith, Watseka Electric Light Co., Watseka, Ill.
R. S. Wells, Edward F. Wells, Shelbyville Water and Light Co., Shelbyville, Ill.
John H. Dale, the Dale Co., New York.
Col. S. G. Booker, Phœnix Carbon Co., St. Louis, Mo.

CHICAGO CONVENTION NOTES.

At the opening session letters of regret were read from the first vice-president, A. M. Young, Thomas A. Edison, Nikola Tesla, Elihu Thomson and Prof. H. T. Bovey.

Invitations to accept the hospitalities of the following companies were read at the opening session: Metropolitan West Side Elevated, South Side Elevated, Northern Steamship Company, asking the members to "inspect" the "Northwest." An invitation for the association to meet in Detroit next year was also read. The Chicago Telephone Company announced that it had placed a special telephone in the secretary's office for the use of the members and visitors. The American Telephone and Telegraph Company announced that it had also placed a long distance telephone at the disposal of the members and visitors.

W. D. Packard, of the New York & Ohio Company, arrived the second day, and had much valuable information to impart concerning the new smokeless lamp.

Manager C. H. Wilmerding, of the Crocker-Wheeler company, had made excellent preparations towards taking good care of the many friends of his company, and at the same time be able to meet the demand upon his time caused by the various interests he is identified with.

The Rockwood Manufacturing Company, Indianapolis, was efficiently represented by its Mr. G. O. Rockwood, who, by means of a friction indicator, had little trouble in convincing engineers of the superior adhesive qualities of the now famous paper pulleys, in the manufacture of which his company is recognized as the pioneer.

Stanley Electric Manufacturing Company had its interests ably looked after by the genial "Will" S. Hine, of the Chicago office. If incidentally the home office receives a few large orders for apparatus within the next few days, it is merely an indication of "Will's" enviable ability to combine business with pleasure.

The Sprague Electric Company early secured suite 128–30 as a place to receive its many appreciative callers, who, without exception, received a most cordial welcome. General Manager Edward H. Johnson found it difficult to do justice to the many demands of old and new friends who insisted on shaking hands with one of the pioneers in the electrical field. Mr. C. A. Benton, from the New York office, was also in attendance, while Manager E. B. Kittle, of the Chicago office, assisted by his aide, Mr. M. B. Kitt, divided the responsibility of doing the honors in a successful manner. Perhaps one of the most effective things in the way of convention advertising consisted of a number of Lundell fan motors, which, from the beginning of the convention, were found scattered throughout the hotels and convention hall, carrying a card with the words, "Lundell Fans Are Standard." The cooling breeze caused by the fans was highly appreciated by all.

The Wagner Electric Manufacturing Company early secured parlor 622 as its headquarters, showing its latest types of high-efficiency transformers.

One of the enjoyable incidents of the convention, not found on the programme, was a trip over the Alley "L," a special train having been tendered to the delegates through the courtesy of President Carter. During the trip an opportunity was given the passengers to fully examine the Sprague multiple unit system in use on the road.

All who passed parlor 132 and did not examine the interesting exhibit of Mr. J. C. Wormley will regret it. In addition to a complete line of standard "Wormley" lamps, one was shown the various stages of lamp filaments during process of manufacture. A line of special lamps for bicycles, carriages, houses and hotels was also shown.

It needed but the presence of president Henry B. Cutter to recall to hundreds of satisfied users of I. T. E. circuit-breakers the amount of money, time and worry this necessary adjunct to every modern switchboard has saved them.

General Manager A. C. Garrison, of the Columbia Incandescent Lamp Company, long ago acquired the convention habit, and never finds a dissatisfied user of Columbia lamps. Chicago Manager G. P. Rex divided his time between the office and convention hall, and made many converts to the Columbia faith.

Among those who have been identified with electrical interests for a decade or more, few are better and more widely known than Mr. J. H. Reid, one of the old timers, who in parlor 1,812 at the Annex received many callers, to whom the high qualities of the product of the Westinghouse Glass Works were duly and convincingly explained by Mr. Reid.

Mr. Edw. R. Grier, of the Bryant Electric Company, Chicago, was a regular visitor at the convention hall, and found few central station men who had not used some of the famous Bryant specialties.

Chas. Munson Belting Company, Chicago, in a happy manner solved the perplexing problem of providing a suitable souvenir that would receive more than passing attention, by distributing an elaborately gotten up war map of Cuba. The map is a thoroughly accurate one, and Manager E. A. Groetzinger is to be congratulated on selecting such a suitable souvenir.

General sales manager R. J. Randolph, of the Sterling Arc Lamp Company, New York, had parlor 1,162 at the Annex fitted up as a testing room to demonstrate the merits of the company's lamps. Constant potential as well as alternating current lamps could be seen in operation, the main features of the exhibit being the A. C. 100 hour enclosed lamp and the six and one-half and nine and one-half ampere series lamps, that worked to perfection and elicited much favorable comment from all who had an opportunity to visit the room.

Manager J. R. Wylie, of the Chicago office Standard Underground Cable Company, was located in parlor 134, where a constant throng of callers kept the room filled every day. The products of the Standard company years ago became standard in the fullest sense of the word.

The Westinghouse Electric and Manufacturing Company, with headquarters at 104 and 106 Auditorium, were ably represented by F. H. Taylor, general sales manager; Arthur Warren and A. S. Morris, of Pittsburgh, and by Maurice Coster, Chicago sales manager; Henry Floy, W. S. Rugg, C. W. Regester and T. J. McGill, of Chicago. The company's headquarters were tastefully decorated in the national and Cuban colors. They exhibited a few well selected pictures, showing the details of their various manufactures and views of their shops. All the above-mentioned gentlemen are well known to the electrical trade, and on account of their popularity the Westinghouse quarters were always thronged with association guests, who were greatly pleased with the arrangements which had been made for their comfort. A very neat effect was exhibited in the form of a shield, with the company's motto "The name Westinghouse is a guarantee" engraved thereon, which is true of their hospitality as well as their high-grade apparatus.

The Sawyer-Man Electric Company had an interesting exhibit of incandescent lamps at their headquarters, and were capably represented by Messrs. F. H. Smith, general manager, of Pittsburgh, and C. H. Ross, of Chicago.

The Okonite Company was represented by Capt. W. L. Candee and Geo. T. Manson from the home office in New York and the Central Electric Company officials in Chicago. The most beautiful souvenir of the convention was given out by the Okonite Company, and consisted of a gilt-framed porcelain plaque bearing a truly artistic hand-painted figure. The picture was a work of art, and the demand was pressing from all sides. The Okonite gentlemen, with proper gallantry, saw that all the ladies in attendance were first supplied. This souvenir, it was freely admitted, carried off the honors of the electric light convention mementoes.

Copies of the ELECTRICAL REVIEW, containing the first day's proceedings and much news of the convention, arrived in Chicago Wednesday evening, and were in demand. The REVIEW had the distinction of being the only paper distributed at the convention containing such a report. The telegraph and fast mails did it.

Few convention exhibits receive as close and attentive an inspection as those of the Wagner Electric Manufacturing Company, St. Louis, which for several years past has been ably represented at all important electrical gatherings. This year its exhibit has been confined to a series of large photographs illustrating various types of the company's apparatus in actual use. Suite 622 was the home of the company's representatives, who were Messrs. E. H. Abadie, general sales manager; W. A. Layman, assistant manager, and S. E. Johannesen and E. S. Pillsbury, of the engineering corps.

A set of the company's well known indicating instruments was shown under current on a model panel board, including an indicating wattmeter, voltmeter and ammeter. A generous supply of the company's literature, interesting as usual, even to a lay reader, was provided, and all callers went away only after a protracted visit in such an interesting place.

Central Electric Company distributed a handsome aluminum tray, with scalloped edges and satin finish, suitable as an ash-receiver for gentlemen or a hairpin holder for the ladies. This souvenir at once became very popular, and it was well that an unusually large stock had been provided.

The Diamond Electric Company, Peoria, Ill., had on exhibition in the corridor of the hotel two samples of the latest type Scheefer recording wattmeter. This meter is of an entirely new form, and is claimed to not have any of the slight faults of the older form. Mr. G. A. Scheefer was in attendance explaining the details, while manager A. M. Searles looked after the business interests in his successful manner.

The Central Electric Company, as one of the representative Chicago concerns, naturally had a large force of representatives on the ground, Messrs. Upham, Cobb, Burton and others vying with each other in properly piloting the company's many friends. President McKinlock and Secretary Brown each managed to steal away from their busy offices at intervals and shake hands with numberless acquaintances.

Mr. T. E. Crossman, who for years has so successfully reported the association's conventions, arrived early, and as usual pleased the ELECTRICAL REVIEW with his promptness in delivering copy after each day's session. Few of our readers who enjoy the complete reports realize the amount of practical experience, exactness and quickness necessary to properly perform such work.

Mr. J. C. Shainwald, Chicago manager for the Standard Paint Company, was a daily attendant and surprised everybody with one of the company's always useful and unique souvenirs. This time it consisted of a neat nail file and cleaner in leather case, probably intended to remind all central station people that cleanliness around a plant can best be attained by a liberal use of P & B.

An immense piece of almost faultless mica, at least half a square yard in size, had been suspended over the main stairway by Mr. Child, Chicago representative of O. A. Schoonmaker. Above the segment was a card with the apt query: "Will this cut your segment?"

The D. & W. Fuse Company, of Providence, showed samples of its latest style non-arcing fuses and safety devices on the parlor floor.

The W. R. Garton Company, of Chicago, recently organized as a consulting engineering firm and manufacturers' agents, took advantage of the convention to call attention to its new venture, Messrs. W. R. Garton and Ray P. Lee meeting many old friends.

Secretary W. B. Hughes, of the Central Manufacturing Company, Chattanooga, Tenn., came up from the South to enjoy the cooling lake breezes, and at the same time meet the very many users of his company's products. The "Central" brand of cross-arms, pins, brackets and mouldings is recognized as a standard one in all construction work.

Secretary Thomas R. Mercein, of the Northwestern Electrical Association, came from Milwaukee early and was kept busy completing final arrangements for the Duluth trip of the association.

The "Dewey" buttons, with the motto "In Tests We Trust," worn by all who had met either of the Wagner Company's representatives, were so numerous as to almost rival the regular convention badge in prominence. The question "Who's got the button?" was easily answered—they all had one.

Among several notable foreign visitors was Mr. E. Dysterud, superintendent of the electric light and power company, Monterey, Mexico. Mr. Dysterud was an attentive and interested listener at the meetings, and spoke in high terms of the quality of American machinery. Mr. Dysterud is operating some 4,000 incandescent and 120 arc lamps, using General Electric apparatus.

One of the pleasant incidents of the convention was a theater party

(Concluded on page 396.)

TRANSFORMER REGULATION.

BY A. R. EVEREST.

The "regulation drop" in a transformer is a drop in voltage at the secondary terminals of the transformer when delivering current, due to internal losses in the transformer itself, the primary voltage remaining constant.

Apparently the easiest way to determine the regulation of a transformer would be by direct measurement of the voltage at the secondary terminals; first, when the transformer is carrying no load, and, secondly, when the transformer is carrying full load, the difference between the two being the regulation drop, provided the primary voltage is kept constant.

In practice, however, this test is attended with a number of difficulties, so great, in fact, as to render the test perhaps the most difficult and unsatisfactory of all transformer tests. Even when the voltage on the primary side is observed by an independent voltmeter and step-down transformer, it may frequently happen that the temperature coefficients of the two voltmeters are not alike, producing discrepancies in the readings, which, in themselves small, produce a large percentage error in the capacity to be finally determined.

Absolutely steady readings are also desirable for the success of this test—a condition which is very seldom attained. The pulsations of a slow-speed engine reflected on the voltmeter needle are often sufficient to make the test absolutely worthless.

There are several other minor factors which tend to disturb this test. Most of them can be met independently, as by exchanging voltmeters between readings, by taking large numbers of readings at each point and averaging results, and so on; but experience continually shows that with the greatest care the results obtained by this method can not always be relied upon.

Perhaps the hardest point of all in connection with the regulation test as commonly made is the difficulty of persuading the station electrician who makes his own tests that his results (often absurd) are open to question.

But since the losses creating the "regulation drop" in a transformer can be independently measured, the calculation of the regulation from these observed losses becomes a simple matter.

The "regulation drop" in a transformer is caused by two losses: first, the energy loss, or C R drop in the transformer windings; secondly, the reactive drop, or "inductance" of the transformer. In certain special cases we must also take into consideration the effect of the magnetizing current in the primary, since when the latter is relatively large it produces a phase displacement between the primary and secondary currents and has the same effect on regulation as an increase in the reactive drop.

When this phase displacement is so small as to be insignificant the calculation of the drop of the transformer is reduced to the resolution of a right-angle triangle.

We draw for the base line the total energy drop, including that in the transformer and in the external circuit.

Perpendicular to this is laid off a line representing the reactive drop in the transformer. (We are here assuming that the external load is non-inductive.)

The hypotenuse joining these two sides of the triangle now represents the primary applied voltage. We may call this 100 per cent.

If the reactive drop is, say, three per cent, the horizontal becomes the square root of 200^2 minus 3^2, or, roughly, 99.2 per cent.

If the known C R drop in the transformer amounts to 2.2 per cent, we have left 97 per cent voltage (equal 99.2 per cent minus 2.2 per cent) at the secondary terminals, as compared with the primary input, or, in other words, there is three per cent regulation drop in the transformer.

In many cases, however, especially when testing an unknown transformer, it is necessary to take into account the effect of the magnetizing current. The calculation is then not quite so simple, but by means of the method shown below the determination can be made with the greatest accuracy. This method has the advantage of appealing directly to the eye by means of the well known "transformer diagram."

Fig. 1 shows the relative directions of secondary current, primary current, the resultant magnetizing force and flux.

O L is the primary exciting current at no load. It consists of two components, O M the true magnetizing component in phase with the flux O M, and M L at right angles to this, which is the energy component representing the energy expended in core loss.

When the secondary circuit is closed, the primary current will adjust itself in magnitude and direction so as to maintain the vector O L as resultant of primary and secondary magnetizing forces.

The magnetic flux O M generates in the transformer windings a voltage O E, 90 degrees behind the flux in phase. This is the active voltage of the secondary circuit, and also appears as a counter electro-motive force in the primary circuit, where it is shown as O I (Fig. 2).

It is here assumed that the secondary circuit is non-inductive, hence the secondary current is in phase with the induced electro-motive force O E. (For simplicity we also assume that the transformer has a 1:1 ratio.) The voltage impressed on the primary to maintain the secondary current must be the resultant of three components (Fig. 2), I O opposing counter electro-motive force 90 degrees ahead of flux O M; D I overcoming primary C R drop in phase with primary current; R D opposing reactive drop, and 90 degrees ahead of primary current. The resultant of these is O R, which is primary impressed voltage.

It will be noted that this primary voltage O R is really the resultant of *two* values, R I the primary impedance drop, I O the secondary induced electro-motive force. If we can calculate these and know the sec. C R, we have the regulation at once.

It will be observed that any increase in magnetizing component increases the lag between primary current O P and counter electro-motive force O I. Since the base line I O of primary impedance triangle (the C R drop) must always be parallel to O P (the primary current), it follows that an increase in magnetizing component will swing the primary impedance vector I R more into phase with the secondary induced volts I O, increasing the value of the primary impressed voltage O R for any given secondary voltage.

If the diagram is plotted on square paper with sufficient accuracy, the regulation can be obtained at once from Fig. 2, since when O R is primary-impressed voltage, O I is to same scale secondary-induced voltage, and may be expressed in per cent of the former. Deducting the secondary C R drop in per cent, we have the percentage of primary voltage appearing at secondary terminals.

But for greater accuracy it is preferable to calculate the side of the diagram.

Let in Fig. 3 the vectors I D and D R be replaced by I J and J R, the vector of primary impedance I R remaining unchanged.

From the known values of primary impedance, C R and reactance, the angle (a) of the impedance triangle is known. The corresponding angle J I R—(b) of the new triangle is equal to (a) reduced by the small angle J I D: But this latter angle is the angle of lag between primary current and counter electro-motive force, and is readily found from the known values of exciting and full load current. (A tabulation of the lag angle for values of exciting current from 5 per cent to 20 per cent is given further on.

Having found the new angle (b), and knowing the value of primary impedance, the new vector J R (which we may call equivalent reactive drop) is found as the sine of the angle (b) and the vector I J (or equivalent primary C R) is cos of same angle.

Having expressed all the values in per cent of primary voltage for convenience, we now resolve the right angle triangle O R J taking O R—100 per cent, R J—equivalent reactive drop per cent, and obtain O J, which is secondary terminal volts per cent ÷ secondary C R per cent ÷ primary equivalent C R per cent. Knowing the last two values, we at once have the per cent of primary voltage appearing at secondary terminals, and, therefore, the *regulation* of the transformer.

As an illustration, the method will be applied to the determination of regulation drop at full load of a transformer on which the following measurements are known.

The measurements of copper loss and impedance drop are made by means of a wattmeter, the secondary of the transformer being short-circuited, as described in Dr. Bedell's paper on transformer regulation.

Capacity of transformer, 2,500 watts.

Ratio of transformation, 1:01.

Primary voltage, 1,000; frequency, 125 cycles.

Copper loss (6^2 R), 50 watts.

C R drop, two per cent.

Impedance drop, 54 volts = 5.4 per cent.

Iron loss, 60 watts.

Exciting current (no load current in primary at 1,000 volts), .125 amperes.

The lag angle of primary current behind counter electro-motive force line is determined from the relative

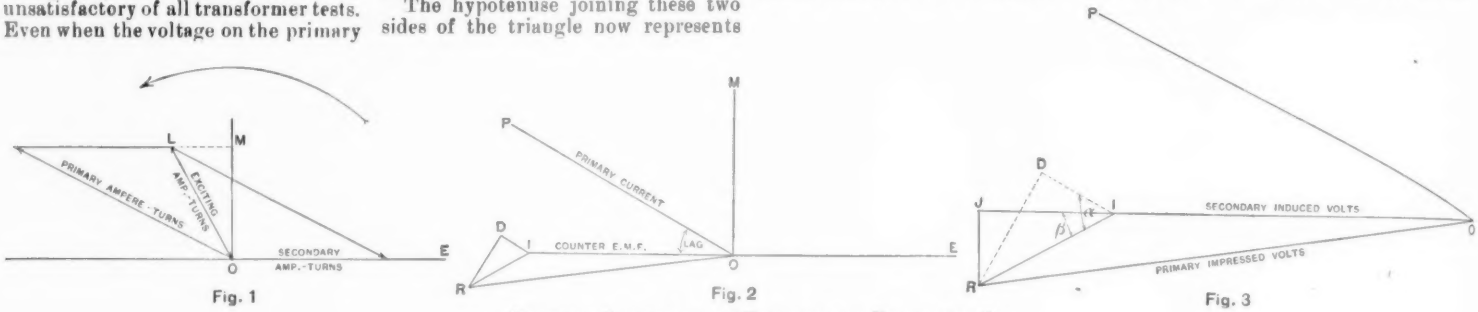


Fig. 1 Fig. 2 Fig. 3

DIAGRAMS ILLUSTRATING "TRANSFORMER REGULATION."

values of primary exciting current and primary full-load current. For convenience, the lag angles are tabulated below for values of exciting current from 5 per cent to 20 per cent, on the assumption that the magnetizing component is 80 per cent of the exciting current. (This is sufficiently accurate for all ordinary transformers on frequencies of 50 cycles and above. The value increases, tending toward 100 per cent, with the large exciting currents accompanying very low frequencies.)

TABLE OF PRIMARY CURRENT LAG.

Per cent Exciting Current.	Angle of Lag.
5 per cent.	.30
8 "	3.50
10 "	4.50
12 "	.50
14 "	.60
16 "	6.50
18 "	7.50
20 "	8.80

This table is not correct for frequencies below 50 cycles.

In the case under consideration we have exciting current five per cent, lag angle two degrees.

The total impedance drop is 5.4 per cent, the C R drop two per cent, and reactive drop

$\sqrt{5.4^2}$ minus 2^2 equals 5 per cent.

The primary impedance drop is resultant of reactive drop and primary C R drop, which we may take as one-half of total C R drop. It is therefore

$\sqrt{5^2}$ minus 1^2 equals 5.1 per cent.

In Fig. 2 we then have

I R minus 5.1 per cent.
I D equals 1 "
D R " 5 "

To find the angle R I D we find what angle has its sine

(R D) equals $\frac{5}{5.1}$ equals .981. The angle is 79 degrees. (See angle *a*, Fig. 3.)

Deducting from this the current lag angle, we have for the angle (*b*) 77 degrees.

J R is the sine of this new angle, and is .974 by 5.1 equals 4.96 per cent. Similarly J I is the cosine of 77 degrees, and is in value .225 by 5.1 equals 1.15 per cent.

To determine the regulation we now resolve the right triangle R O J.

R O equals 100 per cent.
R J equals 4.96 per cent.

J O equals $\sqrt{1002}$ minus 4.96^2 equals 99.87 per cent.

Deducting J I minus 1.15 per cent we have 98.72 per cent as secondary-induced voltage (10), and deducting again secondary C R drop 1 per cent we have 97.72 per cent of primary applied voltage appearing at the secondary terminals or a regulation drop of 2.28 per cent.

It is of interest to note here that, figuring the regulation of this transformer by the simpler method first described, entirely ignoring the effect of exciting current, the result gives 2.13 per cent regulation drop, a difference of 0.15 per cent due to 5 per cent exciting current. With a larger reactive drop in the transformer, other losses being equal, the difference between results obtained by the two methods would be somewhat greater.

Calculated by Dr. Bedell's method, before referred to, the regulation drop obtained is 2.44 per cent—slightly higher than that by the method above. This is due to the fact that Dr. Bedell's method assumes that the magnetizing current is equal to the exciting current, which is not the case, and also in a slight degree to some other minor approximations adopted in the construction of this diagram.

The percentages of iron loss and exciting current taken in the above illustration are higher than would be found in good modern transformers of any but the smallest sizes, but they have been purposely taken here to illustrate the point under discussion. For the same reason the diagrams are greatly exaggerated. In actual practice the primary current line O P is very nearly parallel with the line O I.

Edison Battery Fan Motors.

In the line of electric fan apparatus, the Edison Manufacturing Company of Orange, N. J., and New York city, have this year made some further improvements in fan motors operated by battery power.

The motor is of the Paccinoti ring type, and runs on ball-bearings. A series of tests was made before this form of motor was adopted, the results of which induced them to incorporate that feature in the motor. When this outfit was placed on the market five years ago, a six-pole armature motor was used with a battery of four Edison-Lalande cells. These ran the fan 100 hours, at a speed of 700 revolutions per minute. As a result of the great improvement in the type made this year, with the addition of the ball-bearings, the fan operates at upwards of 850 revolutions per minute, consuming 1.75 amperes of current. The capacity of the battery being 300 ampere hours, the fan can be run 170 hours before necessitating a renewal.

This shows that the efficiency has been increased 70 per cent over that of the original type of fan-motor apparatus constructed. Furthermore, this does not take in consideration the increase of the revolutions from 700 to 850 per minute, which would still further raise the efficiency.

The iron-clad battery fan apparatus made by this company carries a seven-inch fan, using three Edison-Lalande cells, Type "S," in 300 ampere hours. Some modifications and improvements have also been made in this apparatus since last season. In addition to battery fan apparatus, the company are also making a fan motor to operate on 110-volt Edison circuits, which is furnished with a three-speed switch, which operates fans at 1,000, 1,200 and 1,400 revolutions per minute.

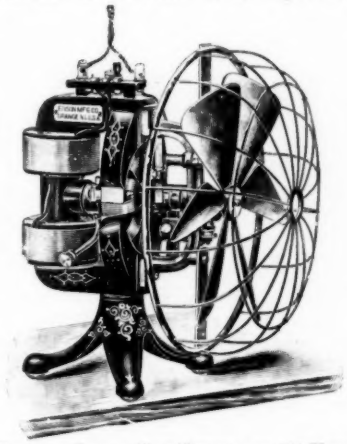


FIG. 1.—EDISON FAN MOTOR FOR 110-VOLT CIRCUITS.

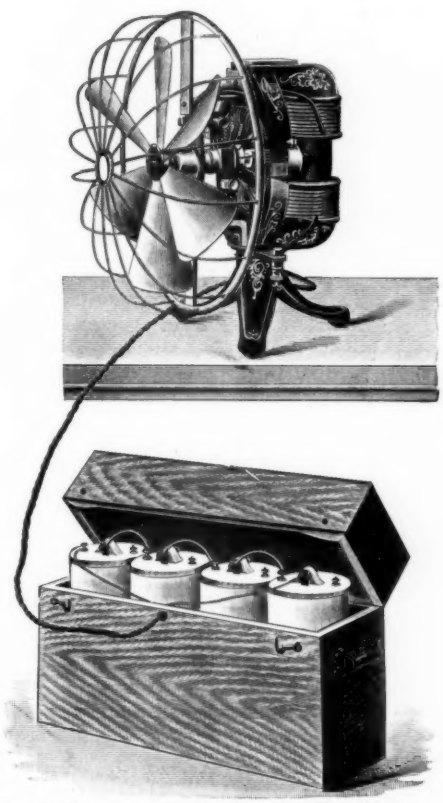


FIG. 2.—IMPROVED EDISON BATTERY FAN OUTFIT.

South Jersey Telephone and Telegraph Company.

At the annual meeting of the stockholders of the South Jersey Telegraph and Telephone Company, of Philadelphia, Pa., the following directors were elected: James E Mitchell, James Merrihew, S. M. Plush, Henry S. Huidekoper, Thomas Sherwin, John E. Hudson and C. A. Janke. The board subsequently organized by the election of these officers: President, J. E. Mitchell; vice-president, James E. Merrihew; secretary, W. T. Westbrook; treasurer, W. J. McLaughlin; superintendent, W. T. Westbrook.

General Merritt To Marry Miss Williams.

The engagement of Gen. Wesley Merritt to Miss Laura Williams, of Chicago, has been announced. Miss Williams is a daughter of Mr. Norman Williams, who is one of the pioneers of the Chicago Telephone Company, is interested in the Western Electric Company, and was for many years connected with the Western Union Telegraph Company. In 1882 he was a representative of the United States at the Paris Electrical Exposition.

Abner S. Adams, of Lowell, Mass., who shot himself last week at the sanitarium in Attleboro, is dead. He was interested in many banking and business concerns in Lowell, and was also a director in the Erie Telephone and Telegraph Company. His estate is estimated to be worth about $2,500,000. About a year ago he entered the sanitarium suffering from nervous prostration.

ELECTRIC LIGHT MEN.

(Concluded from page 393.)

tendered to some 150 of the delegates on Wednesday evening by a self-appointed committee, consisting of Messrs. Jas. Wolff, the prince of entertainers; Geo. Whyte, the famous baritone, and the affable W. W. Low. Upon their return many of the party expressed a conviction that electrical shows are not the only ones Chicago excels in.

Mr. M. B. Austin, who so successfully handles the products of the Safety Insulated Wire and Cable Company in the West and now and then introduces some new and useful electrical specialty to the trade, received a large number of callers, both at his office and the convention, where he could be found whenever business permitted.

General manager G. G. Luthy, of the Royal Electric Company, Peoria, came and told interested central station managers about the large induction alternators now in course of construction at the company's works. In its latest type of machine the company has embodied all that years of experience have demonstrated to be essential in a commercially perfect machine of that class.

The Raster Carbon Rheostat Company's interests were well looked after by Mr. W. R. Garton, the company's consulting engineer. The practicability of carbon as a resistance has been so well demonstrated in the Raster rheostat that any prejudice existing against that material is fast disappearing.

The numerous friends of Mr. Chas. D. Jenney, who has long been recognized as one of the pioneers in the designing and building of light and power apparatus, were glad to shake hands with him in Chicago, and incidentally learned that he is again at the head of a manufacturing concern, a position for which years of experience, coupled with a natural ability as an inventor, so well qualify him.

The souvenirs of the Leschen-Macomber-Whyte Company, distributed by Mr. Geo. Whyte, were appreciated by all who have occasion to jot down memoranda (and who has not?). A handsome seal-bound memorandum book, which just fits the vest-pocket, leaves no excuse to say, "Oh, I forgot all about it!"

General manager Robert F. Carr, of the Dearborn Drug and Chemical Works, Chicago, could be seen among the delegates, selecting particularly those of the station managers who had not yet become convinced of the necessity to have all feed water properly analyzed before attempting to use a scale preventive.

The success of the Dearborn boiler compound, and the results of the company's method of first diagnosing the case and then prescribing a remedy, has been highly gratifying. Mr. Charles S. Kohler, representing the company in Milwaukee, ably assisted Mr. Carr in his mission.

The now well known watch-charm, in the shape of a miniature Wood transformer, was eagerly secured by all who so far did not possess one of the Fort Wayne Electric Corporation's useful souvenirs. Col. Charles Munson, of the Chicago office, took excellent care of all the company's numerous customers and friends.

Mr. Frank Wunder, whose name stood in some danger of beginning to fade in the memory of the western electrical people, laid aside the business cares of his office as New York manager for the Fort Wayne Electric Corporation and, after an absence of two years, once more visited Chicago and the convention, where numberless acquaintances were renewed, and a friendly rivalry ensued between a score or two who were eager to show "Frank" the Chicago of to day.

Western Electric "Standard" fan motors were under current throughout the auditorium, furnishing an unlimited supply of "the wind that never fails."

Eugene Munsell & Company and the Mica Insulator Company, of New York and Chicago, were represented at the National Electric Light Convention, Chicago, by Mr. Chas. E. Coleman, manager of the two concerns in the West. The companies' blotters were distributed freely at the writing rooms and various headquarters of the different companies represented at the Auditorium during the convention.

Mr. C. J. Field, manager of the electrical conduit department Standard Fireproofing Company, New York, arrived with the New York delegation, and during the convention found numerous opportunities to talk sectional conduit to all interested in underground work.

"A Reminder of Ohm's Law" was the useful little souvenir distributed by manager J. R. Wiley, of the Standard Underground Cable Company. It consists of a rotating disk, revolvable between two covers, the upper one having apertures suitably spaced, so that upon giving the disk three quarter turns, one quarter at a time, the three variations of Ohm's law are shown, the fourth quarter giving the word Standard.

Col. S. G. Booker, of the Phœnix Carbon Company, St. Louis, arrived in plenty of time to meet the large numbers of satisfied consumers of his factory's products. If there is anybody who knows everything about carbons and carbon products, it is the Colonel.

Secret Telegraph Sounder Wanted.

A correspondent of the ELECTRICAL REVIEW wants to purchase a secret telegraph sounder "to be worn on the operator's head." The correspondent's address will be furnished on application.

The City Council of Indianapolis, Ind., has approved the contract between the city and the New Telephone Company, with the exception of amending it twice with phrases not objectionable to the company and accepted by the latter.

GENERAL DISTRIBUTION FROM CENTRAL STATIONS BY ALTERNATING CURRENTS.

READ BEFORE THE NATIONAL ELECTRIC LIGHT ASSOCIATION, CHICAGO, JUNE 8, 1898, BY HERBERT A. WAGNER.

Ever since the installation of the first few pioneer alternating-current central stations, just 10 years ago, we have heard it predicted with persistent reiteration that for the distribution of current for lighting from central stations direct current was a thing of the past, and that in a few years the alternating-current transformer system would hold the field without a competitor.

To many, this prediction may seem to have been fulfilled, considering the enormous number of alternating-current plants, compared with direct-current, that have been installed, and the remarkable impetus given to electrical industries by the development of alternating currents.

The great success achieved in the transmission of power by polyphase alternating currents in the last three years has but strengthened this general belief, and left fewer champions to adhere to the direct-current cause.

These great achievements, I say, have led the enthusiast to think all progress confined to alternating systems of distribution. Deeper investigation, however, shows that while in point of number the alternating-current stations, reaching into the thousands, completely overshadow those of direct current, there are few really large stations, outside of water-power plants, that are to-day employing alternating currents for distribution, and that while enormous investments have been made in direct-current stations in our larger cities, comparatively small amounts have been invested in alternating current work.

The alternating system was heralded as providing a means of distribution with a great reduction in first cost of plant, and for years the development of the system has been made with this the principal end in view. On the other hand, direct-current distribution in the form of the Edison three-wire system has been steadily and intelligently developed to the highest standard of economy of operation, simplicity and permanence. In the same city alternating-current stations have not, as a rule, been successful in competition with three-wire stations; their service has not been as good, and their profits have been smaller.

I may startle many by stating frankly the discouraging fact, which has been barely whispered at times, that, judged by the standards of the magnificent Edison properties in many of our larger cities, few alternating-current central stations in the United States have been a success. Do not imagine that this damaging admission, however, is an indication of any loss of faith on the part of one who has been identified with alternating-current work since its debut, as it were. Far from it. The fault lies not with the alternating current itself, but with its application. Its few apparently inherent deficiencies, such as the difficulties of operating motors and arc lamps, have been shown to have been only awaiting discovery and development, and were at our disposal almost as soon as these important divisions of central station service were operated with success from the Edison three-wire system. These can, therefore, hardly be held responsible for the difference in the commercial results obtained with the two systems.

As I have said, the ends in view in the development of the two systems have been radically different. The one was to produce a given amount of light for the minimum of investment; the other was to provide a permanent investment that would render the maximum of profit. These standpoints in general mark the difference between the manufacturer and the user, and we find these two systems developed in this way—one almost entirely by the manufacturer, and the other by the combined efforts of the various users. The results are the natural effects of progression along these lines.

Few opportunities have we had of comparing the two systems from the same standpoint and under like conditions. The purpose of this paper is to show the alternating current applied from the same standpoint, compelled to fulfill the same conditions, and then to compare the results with the best produced with direct current.

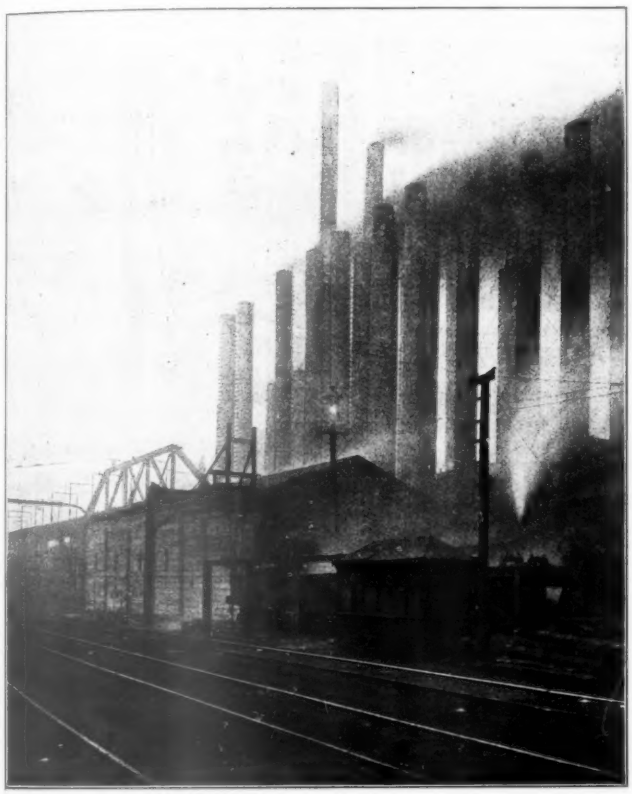
To better contrast the different methods of distribution, we will review briefly those in general use before describing the most recent developments.

The early alternating-current stations were installed on the principle that the drop in lines with distribution at 1,000 volts was so small that it was practically negligible. Two wires were accordingly run out from the station, passing along those streets where light was to be furnished, and lights were connected *ad libitum* at any desired point between the station and the farthest end, without reference to such trifling considerations as difference in potential. Distribution was attempted in this way for years, and in many places is still in operation. Lines are even being constructed to-day without any notion of a system of feeders and mains, although an almost perfect system for the maintenance of uniform pressure was in operation in many Edison stations before the first alternating station was in existence. Fortunately for the operators of such models of simplicity, the current delivered has usually been so small in quantity that with the proverbial No. 6 wire, which seemed to possess virtues not affected by distances, the difference of pressure between neighboring customers rarely exceeded 10 per cent.

(To be concluded.)

The American Stoker.

In line with the universal progress made in all machinery and equipment for the production of electric power, the feature of economy of coal consumption and perfect combustion has not had the attention which the importance of the subject warranted. Within a comparatively recent time this fact has been indicated by the number of forms of fuel economizers and mechanical stokers which have been devised and are now for sale.



COMPARISON OF SMOKE PRODUCTION FROM CHIMNEYS WITH AND WITHOUT AMERICAN STOKERS UNDER THEM.

An invention which is interesting the engineering field, particularly at this time, is a coal-handling apparatus operating mechanically on the "underfeeding" system known as the "American stoker." Some time ago a description of its construction and operation was published here, and since that time a large number of modern steam plants have added the equipment.

The coal is fed in the hopper, carried by the conveyer into the magazine, which it fills, "overflows" on both sides and spreads upon the sides of the grates. The coal is fed slowly and continuously, and, approaching the fire in its upward course, it is slowly roasted and coked, and the gases released from it are taken up by the fresh air entering through the tuyeres, which explodes these gases and delivers the coal as coke on the grates above. The continuous feeding gives a breathing motion to this coke bed, thus keeping it open and free for the circulation of air.

The result of furnaces which are undergoing this operation for the feeding of its fires, and the furnaces which are kept burning by the old process of shoveling great quantities of coal over the surface of the fire by the antiquated method, is splendidly illustrated in the half-tone shown herewith. The smoke-stacks which are emitting no smoke have under them the "American" stoker. The other stacks which are sending forth volumes of heavy and coal-laden smoke, showing most imperfect combustion, have no automatic feeding devices. This illustration shows one of several immense steel plants at Pittsburgh, which have recently adopted this form of economical fuel handling and consumption. Aside from the Edison Electric Illuminating Company's plant in Brooklyn, which originally installed an equipment of 14 and are now putting in an added number, many of the most representative electric light and street-railway power plants throughout the country are either present users of this machine or are now placing them in position.

The manufacturers of this stoker, the American Stoker Company, were originally established in Dayton, Ohio. Last Fall the business was moved to Brooklyn, N. Y., and within a very short time the increase in the demand for the apparatus was so great that the company has removed to a large suite of offices in the new Washington Life Building, corner of Broadway and Liberty street, New York City.

A Battery Fan Outfit — Knapp Motors and Gordon Cells.

With the idea of perfecting a most perfect battery fan outfit, an agreement has been entered into by the Gordon-Burnham Battery Company, whose factory is now at 594 Broadway, New York, and the Knapp Electric and Novelty Company, 47 Warren street, New York, whereby the standard "Gordon" batteries of the former company will be furnished with the several forms of Knapp motors. These motors have been somewhat remodeled with a view of especially adapting them for use with the Gordon cells, for which long life and efficiency, economy, freedom from local action, gases and odors, and low internal resistance are claimed. These cells are equally well adapted for open or closed circuit work, but when used for the latter purpose give from one to six amperes per hour, with an available electro-motive force of 65 to 75 hundredths of a volt.

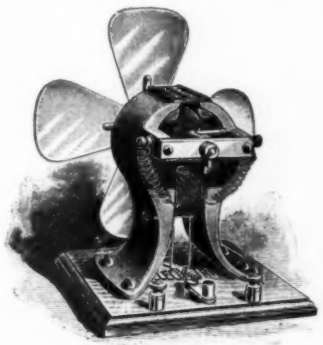


FIG. 1.—VIEW SHOWING CONSTRUCTION OF KNAPP FAN MOTOR.

The Knapp battery motor has a three-pole armature, is mounted on a mahogany base, and is fitted with a pulley and starting switch. This agreement between the two companies in no way interferes with the sale of the Knapp motors without batteries, which they will continue to handle as formerly.

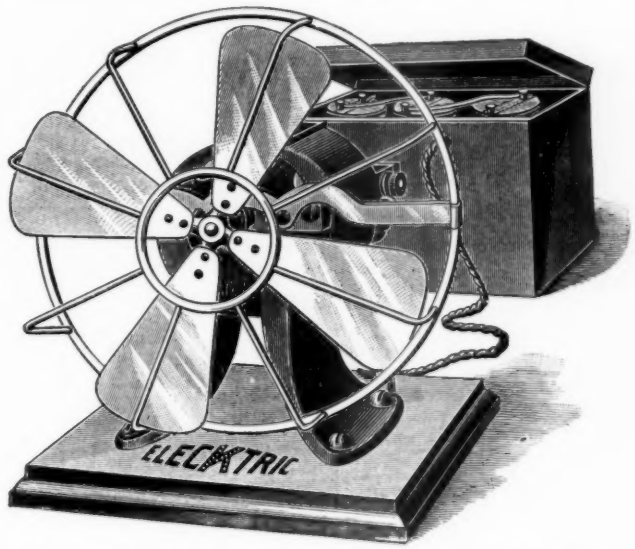


FIG. 2.—KNAPP FAN MOTOR WITH GORDON-BURNHAM BATTERIES.

FORT WAYNE ELECTRIC CORPORATION
FORT WAYNE, IND.
APPARATUS FOR
ARC, DIRECT-CURRENT AND ALTERNATING INCANDESCENT LIGHTING AND POWER TRANSMISSION.

WALKER COMPANY,
ELECTRIC MACHINERY,
CLEVELAND, O.
"The Sun Never Sets on Walker Apparatus."

Kindred.... ...Interests

The Standard Underground Cable Company, of Pittsburgh, has contracted to furnish the government 120 miles of special submarine cable.

The Warren Electric and Specialty Company, Warren, Ohio, advise us that they are receiving a large number of suggestions of names for their new lamp, and as each suggestion must be accompanied with an order they are correspondingly busy, some of a character to provoke mirth and which will be published after the contest is closed and prizes awarded.

The American Stoker Company, Washington Life Building, New York city, has sent out a new and remarkably handsome catalogue describing the well known American stoker, which is used in many prominent electrical plants throughout the country. This catalogue is especially complete, and is very handsomely illustrated. It may be had free on application.

Any one interested in the most perfect types of ceiling fans, column fans, exhaust fans, in fact, all kinds of electric fan apparatus except that made for alternating currents, should see the catalogue issued by the Diehl Manufacturing Company, Elizabethport, N. J., which may be obtained on inquiry at the company's New York office, 561-3 Broadway; 192-4 Van Buren street, Chicago; 128-132 Essex street, Boston.

Some special X-ray apparatus, in the way of Crookes tubes, fluoroscopes, static machines, etc., of the standard makes, is advertised at bargain prices in this issue by Frank Howard, Box 82, Reading, Mass. The advertiser says this apparatus is all the product of standard manufacturers, some of it having been in use for a short time. Those considering purchasing anything in this line will do well to correspond.

Harrison Brothers & Company, of Philadelphia, have issued a new descriptive catalogue and price-list of their well known paints, varnishes and chemicals. The catalogue is accompanied by an interesting pamphlet entitled "Chemistry of Paints," which gives an intelligent idea of chemical and paint-making methods. Harrison Brothers & Company claim for their factory the unique distinction of being the only one in existence that makes all the acids and chemicals used in its finished products.

The Tuerk alternating motor fan apparatus, which has been on the market for some years, has this season been still further improved by the manufacturers, and the Hunter Fan and Motor Company, Fulton, N. Y., are now daily shipping large consignments. There are very few companies that manufacture this alternating fan motor apparatus, and it is generally recognized that that made by this company is the standard. E. B. Latham & Company, 136 Liberty street, N. Y., are the eastern agents for this company, and the Western Electric Company, of Chicago, the agents in the West.

The Wilmot & Hobbs Manufacturing Company, of Bridgeport, Ct., are making extensive additions to their manufacturing plant, which consists of two large buildings. These buildings are to be used as an engine and plating room and a machine or manufacturing building. The engine and plating building is about 60 feet wide and 100 feet long, two stories high, steel frame construction, with brick side walls and concrete floors. The machine building is about 80 feet long and 135 feet wide, and three stories high. This building is of steel skeleton construction throughout. The floors are designed for heavy loads, and are carried on corrugated iron arches supporting concrete filling. The aim in the designing of these buildings has been to get the most convenient structures possible and the maximum amount of light consistent with stability of structure and with economic construction. The designs of the buildings were made by the Berlin Iron Bridge Company, of East Berlin, Ct., who furnish and erect the structural steel work.

The Pope Manufacturing Company, Hartford, Ct., is in daily receipt of evidence of the growing in-

(Continued on page 399.)

A BARGAIN.

We have for sale a 25-horse-power horizontal engine (Nagle, Erie, Pa.) and boiler for same; only used a short time; good as new. Will be sold low.

Address A. H. Potts & Co.,

Parkesburg, Pa.

Site suitable for Power-House or similar use to lease for long term of years. Ground 84x84, within one block of BROADWAY, NEW YORK. Fronting on three streets, more ground adjoining could be acquired. Is high and dry, permitting basement thirty feet deep. Basement could also run under sidewalks of all three fronts. Apply to

HAWLEY & HOOPS,

271 Mulberry Street, New York.

THIS CO HAS BEEN MAKING TELEPHONES 20 YEARS, NOT CHEAP BUT SERVICEABLE AND FULLY GUARANTEED. CIRCULARS FURNISHED. VIADUCT ELECTRIC Co BALTIMORE, MD., U. S. A.

DIRECT-READING AMMETERS OR VOLTMETERS,

Like cut, reading from 0 to 10, at $1.50 each. 0-25 at $5.00 each.

Cherry Electric Works,

25 & 27 3d Avenue, NEW YORK.

Quick-Break Switches.

If you desire the best, latest and most improved quick-break switch on the market, get the

"DEMARY."

They are all made of the best material that can be obtained, and all parts are standard in size.

These switches are made in one grade only, highly polished and lacquered.

Send for Catalogue and Prices.

They will interest you.

R. C. DEMARY,

133 Erie County Bank Building. BUFFALO, N. Y.

MARYLAND AGENTS:

Cookman Electrical Mfg. Co., BALTIMORE, MD.

IRON ROOF FOR SALE.

Dimensions of building - 87 ft. in width, 225 ft. in length, one story in height; side walls and gables of brick; building designed for a machine shop, but, owing to the failure of the purchaser, the iron roof trusses are now offered for sale at a bargain. The roof is admirably adapted for a machine shop, car barn, paper mill, or for any other general manufacturing purposes.

Apply to

THE BERLIN IRON BRIDGE COMPANY,

EAST BERLIN, CONN.

Full of Life and Even Temper!

SMALL SPRINGS OF EVERY DESCRIPTION MADE BY

THE WALLACE BARNES CO.

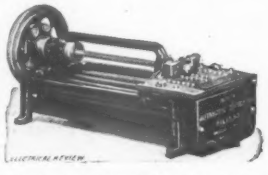
BRISTOL, CONN., U. S. A.

ESTABLISHED 1857.

FLAT OR ROUND WIRE. STEEL OR BRASS. A complete assortment of high-grade COLD ROLLED STEEL kept in stock, .003 to .049 inch thickness.

Springs enameled or plated. Tempering done at short notice. Ribbon steel made to order.

Send samples and write for quotations.



Automatic Motor-Driven Starter.

Engineers and Contractors

Desiring a **thoroughly reliable** Automatic Starting Apparatus for electric pumps, elevators and other intermittent work, can not do better than send for our catalogue of Motor-Driven Starters and Specialties. No dash-pots, shunt magnets or other delicate mechanism, yet automatic start and instantaneous release under all conditions.

Automatic Switch Co., Baltimore, Md.

For New York City and New Jersey, D. H. Darrin, Vanderbilt Bldg., N. Y. For Mich., Wis., Ill., Ind., and Iowa, Harding & Hammer, Marquette Bldg., Chicago. For Louisiana, Vincent Gray, New Orleans.

HOUSE GOODS - A SPECIALTY-

PARTRICK, CARTER & WILKINS 125 So. 2nd. St. PHILA. MANUFACTURERS AND DEALERS

GENERAL ELECTRICAL SUPPLIES

Bargains in Dynamos, Engines, Etc.

Direct-current dynamos of 350, 700, 725, 800, 810, 900, 1,075, 1,350, 1,610 and 2,500 light capacity.
Alternating-current dynamos of 750, 900, 1,800 and 2,000 light capacity.
Arc dynamos, 20, 24, 30, 40, 50 and 60 lights, both 1,200 and 2,000 candle-power.
Engines, 50, 75, 85, 100, 115, 125, 150, 175 and 200 horse-power.
Boilers, 100, 250, 375 and 500 horse-power.
Heaters, 150 and 2,000 horse-power.
Pumps, all sizes.

Write us for Price-list No. 21.

This apparatus has been removed from our own Central Stations to make room for larger units. We therefore know its history and can guarantee it to be in thoroughly good operative condition.

CHICAGO EDISON COMPANY, 139 Adams St., CHICAGO.

KINDRED INTERESTS.

(Concluded from page 398.)

terest of the public in horseless traction. The company's exhibit at the May Electrical Exposition in New York won the undivided favor of critics and observers, both lay and technical. The Columbia motor carriages are necessarily high-priced vehicles, adapted to a special field, which, however, is not confined within narrow limits. The capacity of the batteries of both the single-seated and double-seated carriages is sufficient for 30 miles of travel over fair roads without necessity of recharging, while the average daily mileage of the most constant drivers is but about 18 miles a day. In electric carriages of the highest grade each detail of construction must be of the most expensive and durable character, the material must be the best that money can buy, and only the most skilled workmanship is available in building them. The carriages, therefore, may be classed as luxuries among those who use them mainly for pleasure driving. As their use becomes extended they will undoubtedly be added to the list of necessities by many people—physicians and others whose daily business demands the quickest and most available means of safe transportation about city streets and suburban districts. When one figures in the care and keeping of a two-horse equipage of the better class, the purchase of an electric carriage takes the shape of an economic measure. The Pope company reports the receipt of a number of important orders, several of them from abroad. Four Columbia carriages were recently shipped to Paris.

The "Demary" quick-break switch, which has been recently placed on the market by R. C. Demary, 130 Erie County Bank Building, Buffalo, N. Y., has a number of features which will bring it to the attention of those who are interested in the most approved forms of current control apparatus.

The shops of the Connecticut Telephone and Electric Company, Meriden, Ct., have been operating for months past under very great pressure. This company is now installing a number of exchanges in various parts of the country, which will be among the best yet perfected in the independent field. They have also been for many months incorporating certain advanced features into new switchboard apparatus, which they expect soon to introduce generally before the telephone world.

P & B compounds, which have been so long favorably known to the electrical field, are in greater demand than ever before. These P & B products include insulating compounds, armature and field coil varnish, insulating tape, insulating papers, rubberoid roofing and preservative paints. The Standard Paint Company, 81–83 John street, New York, will send circulars and descriptive matter on application, or information may be obtained through their representative at Chicago.

The Washington Carbon Company, Pittsburgh, Pa., since the introduction of the enclosed arc light, have devoted much study toward perfecting a carbon which should attain the highest results for enclosed arc lighting systems. As a result of these tests, they are now making a carbon which is being very generally used for enclosed lighting. In addition to this special carbon, they are large manufacturers of direct and alternating cored carbons, solid series carbons, carbon brushes, and all forms of carbon, as it is adapted for special purposes in electric work.

The factory of the Safety Insulated Wire and Cable Company in New York has been operating for months past under almost double time, with a large complement of men. The government orders, which have been placed with them, and the largely increased demand for all forms of "Safety" wires, has almost taxed their capacity. This company has recently issued one of the most artistic brochures ever gotten up by an electrical company, which will be sent to all applicants who may be interested in wires and cables for any service.

The amount of attention which the MacIntire arc lamps received at the recent Electrical Exposition in New York has brought them prominently to the attention of many of the representatives of electric lighting stations at the Chicago convention. The MacIntire system involves a number of different forms of arc lighting features, among which are the pendent lamps, street-post lamps, newel-post lamps, arcolier lamps, etc. The International Arc Lamp Company, Mercer and Houston streets, New York, will send catalogue, illustrating and describing the different forms of MacIntire lamps, to any who makes an inquiry.

The Lynn Incandescent Lamp Company, Lynn, Mass., are beginning the manufacture of a lamp which is to be known as the "New Lynn" lamp, to distinguish it from the "Lynn" refilled lamps. They claim many favorable features for the new lamp, as the result of their long experience in handling, for refilling, lamps of every other manufacturer in this country. They say that the form of filament used in the new lamp has every possible advantage of the double filament type without the disadvantages. The curve of the spherical illumination is almost a circle, and appears when burning like a solid cylinder or lamp, which is diffused equally in all directions.

The Upton "Midget" enclosed arc lamps, illustrated in the advertising columns of this issue, are commended by lighting experts as being one of the most unique in the matter of satisfactory operation and appearance of the many types of enclosed arc lamps now on the market. These "Midget" lamps are designed for alternating-current and for constant-current circuits, consuming four to seven amperes of current, and are interchangeable without any adjustment. The average life of the lamp is 125 hours and is perfectly noiseless in operation. Any one who is following the rapid progress in arc lighting should not fail to send to the manufacturers for an illustrated catalogue, the Standard Thermometer and Electric Company, Peabody, Mass.

INDIA AND AMBER
MICA
In any shape or pattern
EUGENE MUNSELL & CO.,
218 Water Street, NEW YORK.
117 Lake Street, CHICAGO.
Write for Samples & Prices

MICA
All Sizes and Patterns
Write for samples and quotations
A. O. Schoonmaker
158 WILLIAM ST., NEW YORK

J. C. WHITE & COMPANY,
INCORPORATED.
ENGINEERS, CONTRACTORS,
29 BROADWAY, NEW YORK, N.Y.
EQUITABLE BLDG., BALTIMORE.

Magnets
Telephone Induction Coils, Ringer and Bridge Bell Magnets, Drop Magnets, etc., etc., also
GAS LIGHTING SPARK COILS,
THE VARLEY DUPLEX MAGNET CO., 138 Seventh Street, Jersey City, N. J.

SWITCHBOARD VOLTMETERS
Ammeters, Ground Detectors and Differential Voltmeters.
We meet all the requirements of modern Central Stations or Isolated Plants, whether using direct or alternating-current circuits.
Our instruments are constant and durable, sensitive and accurate, pleasing in appearance and always correct.
We also manufacture a full line of Portable Instruments. Send for our complete catalogue.

Type "K."
Illuminated Dial.
Keystone Electrical Instrument Co.,
Ninth Street and Montgomery Avenue,
PHILADELPHIA.
NEW YORK, 15 Cortlandt. CHICAGO, 807 Ashland Block.

CAN I BECOME AN ELECTRICAL ENGINEER
For our free book, entitled "Can I Become an Electrical Engineer?" address
The Electrical Engineer Institute of Correspondence Instruction,
CONDUCTED UNDER THE AUSPICES OF "THE ELECTRICAL ENGINEER."
Herman A. Strauss, E. E., General Manager. 120 Liberty Street, New York, U. S. A

Electrical.... Patents.

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED MAY 31, 1898.

604,911 Electric railway; F. D. Sweet, Elyrin, Ohio.

604,949 Rheostat for electric lamps; R. H. Wappler, New York, N. Y.—In an electric circuit, a rheostat composed of a metal tube with enamel or similar insulating material upon the surface thereof, and naked wire having an oxydized surface closely wound upon the insulating surface of the metal tube and a sliding contact in the electric circuit resting on the convolutions of the wire, for varying the resistance in the circuit.

604,953 Reading attachment for meters; C. L. Arques, San Jose, Cal.—A reading attachment for meters provided with an apertured plate, and a ring-shaped dial mounted to turn on the plate concentric with the aperture in the plate, to permit of viewing the meter dial and setting the said ring-shaped dial according to the position of the pointer on the meter.

605,013 Switching device and circuit arrangement for electrically-propelled vehicles; E. B. W. Reichel, Berlin, Germany—Consists of a trolley arm adapted to engage the trolley conductor, a motor circuit connected therewith, a lamp circuit and an accumulator, a contact part connected therewith and a contact piece actuated by the trolley arm to move into engagement with said contact part when the said trolley arm is connected with the trolley conductor.

605,023 Electric switch for use with electrically propelled vehicles or locomotives; A. T. Snell, London, England

605,026 Globe for incandescent lamps; V. de Spruner-Mertz, Brussels, Belgium.

605,066 Third-rail underground electric railway system; L. E. Walkins, Springfield, Mass

ISSUED JUNE 7, 1898.

605,067 Electric switch; C. C. Badeau, Schenectady, N. Y.—In an electric switch, the combination of a switchboard, stationary switch members secured to said board, a pivoted switch-blade co-operating with said switch members and made from a strip of metal bent lengthwise upon itself, and of substantially uniform width throughout, and a handle secured to the switch-blade at the bend.

605,088 605,089 Paper-feeding machine; T. C. Dexter, Pearl River, N. Y.

605,090 Electric apparatus for charging furnaces; J. P. Eck, Muncie, Ind.—In combination with a charging apparatus, two charging tracks, two trucks adapted to run thereon, a shaft for connecting the trucks, a hollow charging bar, an operating rod journaled in the ends of the charging bar, a cam formed at one end of the operating bar adapted to engage the shank of the charging pan.

605,097 Telephone system; Ed W. Ham, Worcester, Mass.

605,174 Induction coil; A. L. Bogart, Jamaica, N. Y.—In a Ruhmkorff induction coil, the combination with the primary and secondary coils, of a condenser arranged in the same plane therewith and partially inclosing the same.

605,194 Electric transformer; J. J. Bellman, New York, N. Y.—The combination in a transformer of a ferro magnetic field built up of integral plates so mortised that when the plates are properly assembled the core of the magnetic field will be approximately circular in cross section.

605,197 Electrical valve controlling device; A. E Colgate, New York.

605,228 Electric arc lamp; W. Hochhausen, Brooklyn, N. Y. In an arc lamp, the combination with the upper or lower ends or plates of a chambered column, connecting them and the casing extending from one plate to the other and provided with a door for closing the chamber in said column.

605,261 Third rail for electric railways; S. H. Short, Cleveland, Ohio.

605,309 Electric selector system; T. C. Drake, Malta, Ohio—The combination with a verticle lever, an angle lever and armature, a contact screw, insulated therefrom, of a retractile spring, in electrical connection with said contact screw, and insulated from said lever to form a conductor for circuit.

605,317 Electric railway system; W. Lawrence, New York.

605,326 Trolley connections for electric cars; J. G. McLaughlin, Brooklyn, N. Y.—The combination with a trolley pole, a swinging frame having cheeks extending upward, above and beyond the extremity of the trolley pole, and a wheel mounted between the upwardly projecting cheeks of the swinging frame.

605,341 Telephone system; R. T. Reid, Tacoma, Wash.

605,345 Call-box system; A. E. Dean, Tacoma, Wash.—A messenger call system, comprising main wires, a battery in the main wires for operating all the call-boxes, an ordinary call-box circuit, normally closed contact fingers arranged in said circuit, an auxiliary circuit comprising a resistance and transmitter, and means for connecting said auxiliary with main line wires.

605,358 Signaling device; F. B. Taylor, Tacoma, Wash.

605,359 Railway signaling and switching device; J. D. Taylor, Chillicothe, Ohio.

TRADE NOTES.

An excellent engraving, made from a photograph of the plant of the New York & New Jersey Concentrating Company at Edison, N. J., has been recently distributed by the Clonbrock Steam Boiler Company in Brooklyn, N. Y. This company has a power equipment of Morrin "Climax" boilers of 950 horse-power installed there. The plant at Edison, N. J., is the great hobby of Edison's life at the present time, and the fact that the entire equipment is the most modern and perfect that could be selected may be taken as an excellent endorsement of the "Climax" boiler.

Care of the commutator—The natural trend of progress in the care of electrical machinery has gradually relegated oils, vaseline and the like to the rear, and an intelligently prepared compound, such as Gale's, has taken their place. Much loss of power, a good deal of wear and tear, and sometimes as serious a loss as a fire has been caused, to a certain extent, by the older methods of commutator lubrication. One of the most skillful electrical engineers conceived and perfected a formula under which Gale's commutator compound is manufactured, and the combination of ingredients is said to be based upon strictly scientific principles. The utility of this compound has been demonstrated to the operators of commutators, both in this country and abroad, so frequently that it is almost unnecessary to dilate upon its merits. Those operators of electrical machinery, who may still adhere to the older so-called lubricants, should secure a sample of Gale's, every supply house in the United States and abroad having arranged with Messrs. K. McLennan & Company, Chicago, to supply a free sample stick upon request, as announced in our advertising columns.

CROFTON STORAGE BATTERY CO.
J. K. PUMPELLY, Manager.
VERY LIGHT BATTERIES
A SPECIALTY.
327 DEARBORN STREET, CHICAGO.

ELECTRICAL ENGINEERING
TAUGHT BY MAIL
Learned by study at home in your spare time. Able instructors. Superior text-books free. Fees moderate.
$2 in ADVANCE and $2 a MONTH
Pays for a College Education at Home.
Established 1891. 35,000 students and graduates. Courses in Steam, Mechanical or Civil Engineering; Mathematics; Chemistry; Mining; Architectural or Mechanical Drawing; Surveying; Plumbing; Architecture; Metal Pattern Drafting; Prospecting; Book-Keeping; Shorthand; English Branches.
References in every city and town. All who study guaranteed success. We have helped thousands to better positions. Circular free. State subject you wish to study.
INTERNATIONAL CORRESPONDENCE SCHOOLS,
Box 956 Scranton, Pa.

WM. WURDACK,
Electrical Engineer
—AND—
Contractor,
No. 19 S. 11th St., ST. LOUIS.
Western Agent:
Triumph Dynamos.
Triumph Motors.
Triumph Power Generators.

A $7.00 BOOK of EUGENE FIELD'S POEMS
Handsomely Illustrated by thirty-two of the World's Greatest Artists
Given Free
to each person interested in subscribing to the Eugene Field Monument Souvenir Fund. Subscriptions as low as $1.00 will entitle the donor to this handsome volume (cloth bound, size 8x11), as a souvenir certificate of subscription to the fund toward building a monument to the Beloved Poet of Childhood.
But for the noble contribution of the world's greatest artists this book could not have been manufactured for less than $7.00.
Address
EUGENE FIELD MONUMENT SOUVENIR FUND,
180 Monroe Street, Chicago, Ill.
Mention this journal, as this is inserted as our contribution.

PATENTS TRADE-MARKS COPYRIGHTS
EDWARD S. DUVALL,
Solicitor of Patents,
Counsellor in Patent Causes.
Some time connected with the late Benjamin Butterworth, before he retired from practice to assume the office of Commissioner of Patents.
Prompt attention given to all matters before the Patent Office, and applications for patents prepared here at Washington from sketches, photos, or models, in a manner to give highest satisfaction and with less expense than you will incur elsewhere. Write and convince yourself of this fact. As an attorney at Washington is indispensable you can save the expense of having two by communicating directly with me.
LOAN AND TRUST BUILDING,
WASHINGTON, D. C.

SAFETY
RUBBER COVERED
WIRES AND CABLES
FOR EVERY SERVICE.
For Underground, Aerial and Submarine use, "Safety" wires and cables have the indorsement of some of the largest users in the United States. Write for our booklet containing the experience of users.
THE SAFETY INSULATED WIRE & CABLE CO.,
225 to 239 West 28th Street, New York.
LEONARD F. REQUA, General Manager.

M. KLEIN & SON.
KLEIN'S CLIMBERS
Connectors's, Linemen's and Construction Tools
Catalogue Free... Send for one
MATHIAS KLEIN & SON,
87-89 W. Van Buren St.. . Chicago, Ills.

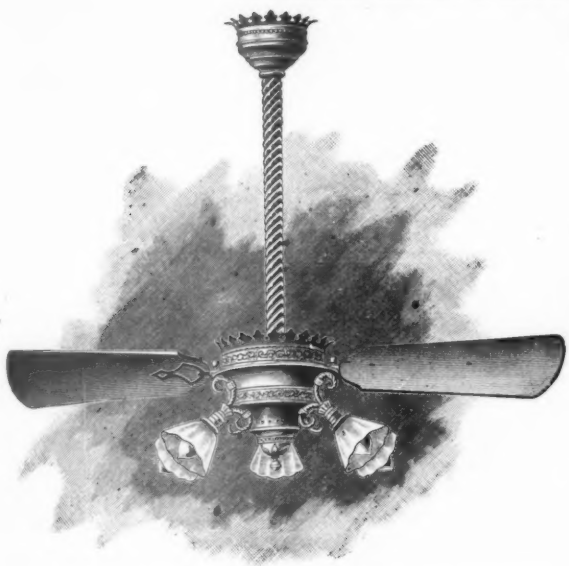
THE BRADY MAST-ARMS.
T. H. BRADY, New Britain, Conn., U. S. A.
Manufacturer of Mast-Arms, Pole and Swinging Hoods, House Brackets and other Specialties for Construction Work.—*Catalogues and Prices furnished on application.*

USE THE BEST.
John Weldon's Hand-made CLIMBERS.
JAMES S. BARRON & CO., Selling Agents,
24-30 Hudson St., New York.

DIEHL FANS

FOR ALL CIRCUITS, EXCEPT ALTERNATING.

Our Ceiling Fans and Electroliers are the RECOGNIZED STANDARD of the World.



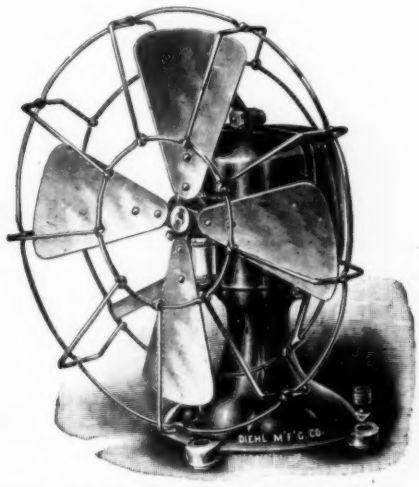
OUR DESK AND BRACKET FANS ARE BUILT OF THE FINEST MATERIAL AND HAVE THE

HIGHEST EFFICIENCY

OF ANY ON THE MARKET.

WRITE FOR CIRCULARS AND PRICES

— ON —



CEILING FANS, COLUMN FANS, COUNTER-COLUMN FANS, DESK FANS, BRACKET FANS, EXHAUST FANS.

SHOWROOMS: { NEW YORK, 561-563 Broadway. CHICAGO, 192-194 Van Buren Street. BOSTON, 128-132 Essex Street.

DIEHL MANUFACTURING CO.,
ELIZABETHPORT, N. J.

Walker Company,

Cleveland, Ohio. . . .

Why is Walker Apparatus in use all over the World?
Because its design is superior to all others, its workmanship is of the best, and its performance always comes up to the expectations of its purchasers.

Arc Lamps for Direct or Alternating Current.
Direct and Alternating Generators for Lighting.

The Sun Never Sets on Walker Apparatus.

Walker Company, Cleveland, Ohio. New Haven, Conn.

General Sales Office, No. 20 Broad Street, New York City.

Agencies in all Principal Cities.

CARBON SPECIALTIES

Battery Cylinders, Telephone Transmitter Carbons, Carbon Brushes and Electric Light Carbons.

SOLAR CARBON & MANUFACTURING CO.

339 FIFTH AVENUE, PITTSBURGH, PA.

FARADAY CARBON CO.,

ELECTRIC LIGHT CARBONS,

JEANNETTE, PA.

A. L. BOGART CO.

Electric Gas Lighting Specialties

Removed to

123 Liberty St., N. Y. City.

W. R. OSTRANDER & CO.

22 DEY STREET,

Manufacturers of

SPEAKING TUBES, WHISTLES, ANNUNCIATORS.

Electric and Mechanical Bells.

FACTORY,

DE KALB AVENUE, BROOKLYN.

Send for Illustrated Catalogue.

OUR **CROWN BRUSH**

Made flexible end-ways, side-ways or stiff. Send for samples and price list, and compare with other makes.

Crown Woven Wire Brush Co., Salem, Mass.

EFFICIENCY GUARANTEED. PRICES REDUCED. HIGHEST POSSIBLE CONDUCTIVITY.

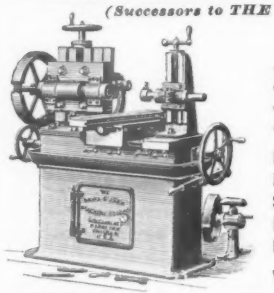
Write us, stating size, and let us quote you and send you sample.

Our prices will save you *dollars.*

OHIO ELECTRIC SPECIALTY MFG. CO., TROY, OHIO.

THE AMERICAN TOOL WORKS CO.

(Successors to THE DAVIS & EGAN MACHINE TOOL CO.)



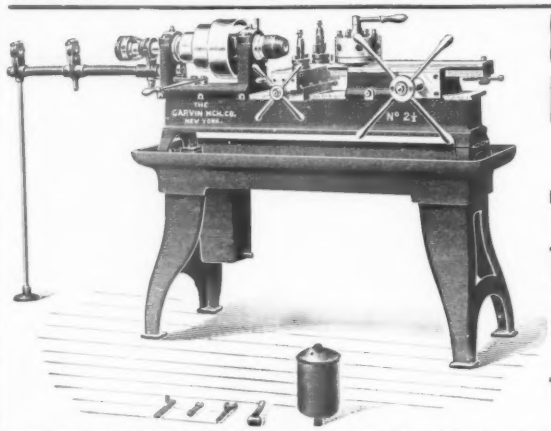
Designers and Builders of

IMPROVED MACHINE SHOP EQUIPMENTS.

LATHES, PLANERS, BORING MILLS, SHAPERS, UPRIGHT AND RADIAL DRILLS, MILLING MACHINES, SCREW MACHINES, BRASS WORKING TOOLS, PUNCHES AND SHEARS, BOLT CUTTERS, PULLEY LATHES, SHAFTING LATHES, ETC.

Works: **CINCINNATI, OHIO, U. S. A.**

NEW YORK: 107 Liberty Street. | CHICAGO: 68 South Canal Street. | BOSTON: 36 Federal Street. | PHILADELPHIA: 19 North Seventh Street.



SCREW MACHINES.

ALL STYLES.
ALL SIZES.
NEW AND IMPROVED.
SEND FOR CIRCULARS.

THE GARVIN MACHINE CO.,
Spring and Varick Streets,
NEW YORK.

BERLIN STORE: The Garvin Machine Company, m. b. H., 17 Burg Strasse, Berlin, C. Germany.
PHILADELPHIA STORE: The Garvin Machine Company, 51 North 7th Street, Philadelphia, Pa.

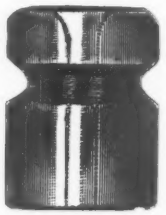
PORCELAIN MANUFACTORY.

Empire Clay Works.

146-148 Greene St. Section C

MAKERS OF HARD PORCELAIN, CUT-OUTS, SWITCH BASES, INSULATORS &c.

BROOKLYN, N.Y.



HABIRSHAW WIRES AND CABLES

have been, are now, and always will be

THE BEST

THE

INDIA RUBBER and GUTTA-PERCHA INSULATING CO.

MAIN OFFICE, GLENWOOD WORKS,

J. W. GODFREY, Manager Sales,
15 Cortlandt St., NEW YORK.

YONKERS, N. Y.

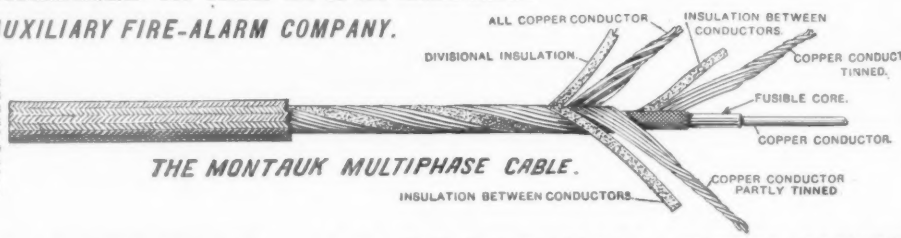
INTERIOR THERMOSTATIC ELECTRIC CABLES.

STANDARDIZED IN ALL B. & S. GAUGES.

RECENTLY ADOPTED BY THE GAMEWELL AUXILIARY FIRE-ALARM COMPANY.

We own the following Letters Patents issued by the United States, which broadly cover the construction and basic principle of our Cables, viz.:

No. 546,261
" 546,262
" 565,053
" 565,178
" 565,188
" 565,217
" 565,410
" 594,034
" 594,247
" 594,281

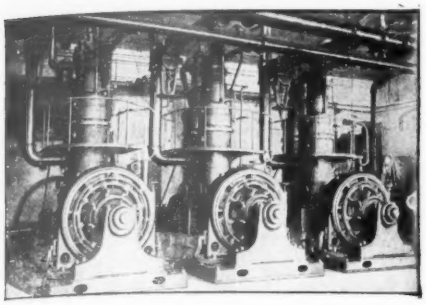


THE MONTAUK MULTIPHASE CABLE.

Write for Descriptive Matter.
Call and See Cables Demonstrated.

MONTAUK MULTIPHASE CABLE CO., 100 BROADWAY, NEW YORK.

Telephone, 4031 Cortlandt.



DIRECT-COUPLED UNITS FOR ARC LIGHTING

Engines Especially Designed for This Service.
Dynamos Especially Designed for These Engines.

CENTRAL VALVE ENGINES.

Compound or Triple Expansion. Condensing or Non-Condensing.

GIVE MAXIMUM ECONOMY.

Over 215,000 I. H.-P. in use and on order.
Lowest Cost Per K. W. Hour. Highest Efficiency. Combined Sets Occupy Smallest Possible Floor Space.

M. C. BULLOCK MFG. CO., 1179 W. Lake St., CHICAGO.

The Monarch Engine-Stop with Speed-Limit

attachment will positively prevent an engine from running away, and also enable it to be stopped from any point in the factory in case of accident, notifying the engineer at the same time. It is a first-class insurance at a low cost. It closes the Throttle-Valve. Why not investigate?

New York Office: 39-41 Cortlandt St. **The Monarch Manufacturing Co.,** Waterbury, Conn.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY,

CINCINNATI, OHIO.

DESIGNERS AND ENGRAVERS
BY ALL METHODS
Electrical Machinery and Apparatus
A SPECIALTY
GET OUR PRICES AND SPECIMENS BEFORE BUYING.

THE BROWN-BIERCE COMPANY.
DAYTON, OHIO.

ELECTRIC CONDENSERS.
Wm. Marshall, Manufacturer.
STANDARDS A SPECIALTY
709 Lexington Avenue, New York.

ARMINGTON & SIMS ENGINES, 1898 PATTERN.

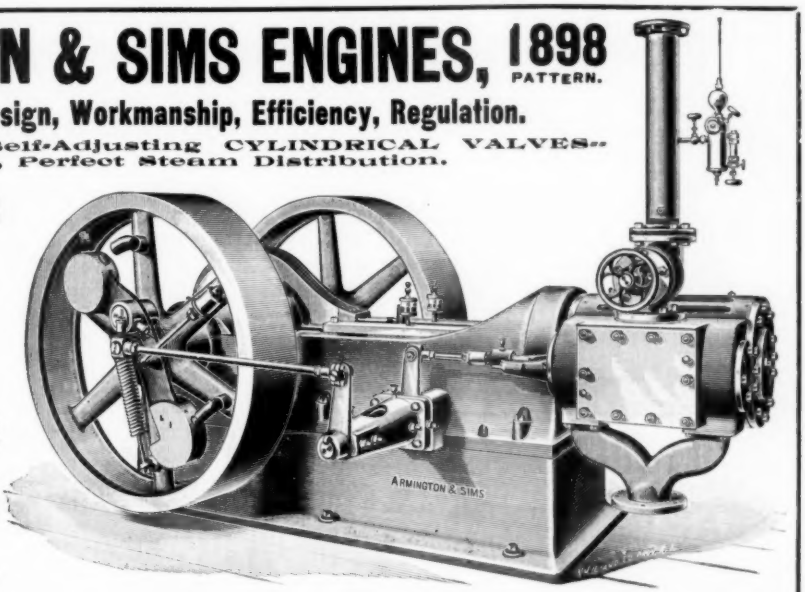
Unexcelled in Design, Workmanship, Efficiency, Regulation.

Double-Ported, Self-Adjusting CYLINDRICAL VALVES.. Absolutely Tight, Perfect Steam Distribution.

RITES INERTIA GOVERNOR
Simple, Powerful, Effective.

ENGINES
30 to 2,000 Horse-Power Capacity, to meet the requirements of any service.

We invite correspondence with all interested in the economical development of power.



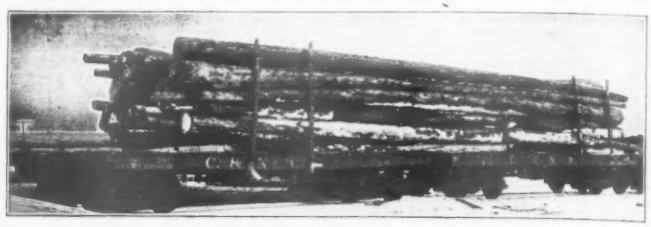
ARMINGTON & SIMS CO.
(Successors to Armington & Sims Engine Co.)
PROVIDENCE, R. I.

NEW YORK: W. F. HARING, 1106 Washington Life Bldg. BOSTON: F. B. ARMINGTON, 70 Kilby St. PHILADELPHIA: F. E. BAILEY & CO., 913 Betz Building. BALTIMORE, MD.: MORTON, REED & CO.

E. E. NAUGLE W. H. HOLCOMB A. P. HOPKINS.

NAUGLE, HOLCOMB & CO.
CONTRACTORS
ELECTRIC STREET RAILWAYS.
Railway Ties. Telegraph Poles. Paving.
355 DEARBORN STREET. Chicago.

GEO. WESTON, MANAGER, Construction Department.
GEO. WILLSON, SUPERINTENDENT, Paving Department.
J. H. BURWELL, GENERAL AGENT, Minneapolis, Minn.
F. P. FURLONG, AGENT, St. Louis, Mo.



150,000 POLES IN STOCK.

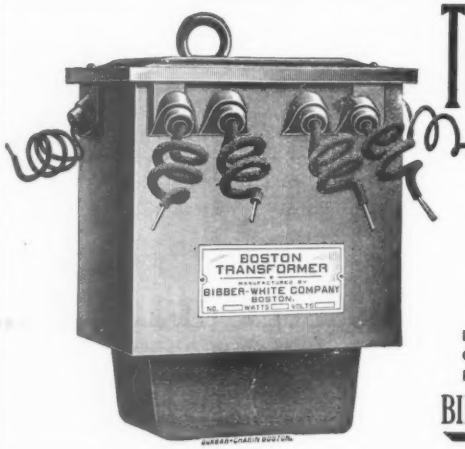
WE BUILT, EQUIPPED, AND OPERATED THE SUBURBAN RAILWAY IN CHICAGO (OVER 50 MILES OF THE HEAVIEST ELECTRIC RAILWAY) WITHOUT THE SALE OF A SINGLE BOND.

STREET RAILWAY TIES A SPECIALTY.

NOVELTY ELECTRIC Co.,
PHILADELPHIA, PA.

Agents for
- Okonite Insulated Wires.
- Medbury Overhead Railway Material.
- Changeable Electric Headlights.
- Globe Metal Works' Trolley Wheels.
- P & B Electrical Compounds.
- Perkins Incandescent Lamps.
- Schiff, Jordan & Co.'s Ship Cored Carbons.

ELECTRICAL SUPPLIES OF EVERY KIND.



Transformers

EFFICIENCY—THE HIGHEST.
REGULATION—CLOSEST.
CORE LOSS—SMALLEST.

Guaranteed against burn-outs of any kind, including lightning, for two years.

ELECTRICAL MERCHANDISE OF EVERY DESCRIPTION.. MADE BY.....

BIBBER-WHITE COMPANY

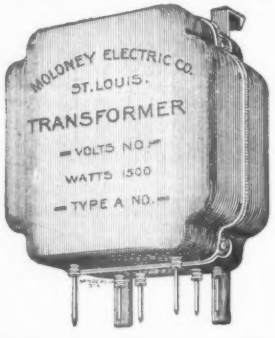
49 FEDERAL STREET, - - - BOSTON.

FORT WAYNE ELECTRIC CORPORATION
FORT WAYNE, IND.

APPARATUS FOR
ARC, DIRECT-CURRENT AND ALTERNATING INCANDESCENT LIGHTING AND POWER TRANSMISSION.

THE

NEW TRANSFORMER



HIGHEST EFFICIENCY.
SMALLEST CORE LOSS.
CLOSEST REGULATION.
PERFECT VENTILATION.
GUARANTEED against Burn-out for TWO YEARS.

Send for particulars to

MOLONEY ELECTRIC CO.
No. 6 N. 12th Street, ST. LOUIS, U. S. A.

THE AWL-ROENTGEN-LIGHT TUBES.
COOLED TARGETS ⁘ OXYGEN VACUUMS.
POWER ⁘ DIFINITION ⁘ LONG LIFE.
KIRMAYER AND OELLING, BOSTON.

McINTIRE'S PATENT
CONNECTORS AND TERMINALS.
Special Connectors for HARD-DRAWN COPPER WIRE, *All Sizes.*
Fused Wire, Fused Links and Strips.
The C. McINTIRE CO., 13 & 15 Franklin Street,
Newark, N. J.

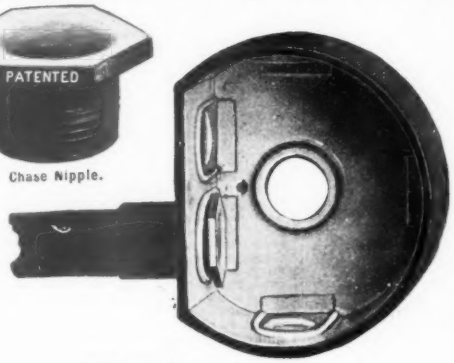
DRILLS, REAMERS, TAPS, ETC.

TOOLS.

HAMMACHER, SCHLEMMER & CO.,
209 Bowery, New York.

FILES, SAWS, WRENCHES, ETC.

Chase Nipple.


Chase Wall Box for Two Conduits.

THE CHASE SYSTEM OF "KNOCK-OUT"

Chase Ceiling Outlet Box.

Outlet and Junction boxes provide for every demand that may arise in wiring a building using iron-armored or enameled conduits.

The boxes are so constructed as to have at frequent intervals on their surface thin webs or films which a slight blow of a hammer will **"knock out,"** leaving round holes for outlets in as many combinations as are generally required.

Chase Wall Box with Recess.

Chase Boxes can be instantly disconnected from the conduit by unscrewing the nipples from the *inside* of the box, thus allowing the box to be withdrawn, regardless of the number of conduits that enter it.

Light, Strong and Perfectly Insulated with Hard, Smooth Enamel.

WRITE US FOR CIRCULARS AND PRICES.

Chase Ceiling Box for Terra-Cotta Work.

L. A. CHASE & CO. (Incorporated), 161-163 Fort Hill Square, BOSTON, MASS.

Double Globe Enclosed Arc Lamp.

For All Standard Voltages 60 or 125 Cycles

Alternating Current ENCLOSED ARC LAMPS

Manufacturers of the STANDARD ELECTRIGAL APPARATUS of the World

80 to 100 Hours' Light with One 9½ inch Carbon

Single Globe and Reflector Enclosed Arc Lamp

General Electric Company

Sales Offices in All Large Cities of the United States.

SCHENECTADY, N. Y.

JUST PUBLISHED.

Second Edition, Revised and Much Enlarged.

Gas, Gasoline AND Oil Engines

By GARDNER D. HISCOX, M. E.

THE ONLY AMERICAN BOOK ON THE SUBJECT.

A book designed for the general information of every one interested in this motive power, and its adaptation to the increasing demand for a cheap and easily managed motor requiring no licensed engineer.

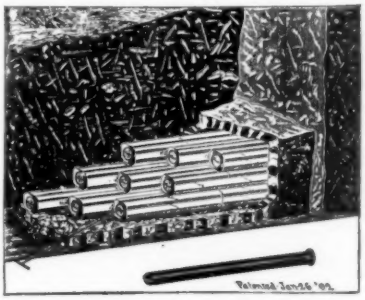
The book treats of the theory and practice of Gas, Gasoline, and Oil Engines, as designed and manufactured in the United States. It also contains chapters on Horseless Vehicles, Electric Lighting, Marine Propulsion, etc. *348 Pages.* *Price, $2.50.*

PREPAID TO ANY ADDRESS, ON RECEIPT OF PRICE, $2.50.

Address: ELECTRICAL REVIEW, 41 Park Row, N. Y.

THE H. B. CAMP COMPANY'S

VITRIFIED CLAY CONDUIT



For Underground Telephone, Telegraph or Electric Light Wires.

This conduit is made of vitrified clay, standard size, three inches internal diameter. We can make any size or multiple of ducts desired. Laid with our patent Mandrel, a perfect alignment is insured. We claim for strength, economy, durability, simplicity, cheapness and perfect insulation it is the best. In use by the most prominent companies. Any information cheerfully given.

Write for Catalogue.

MANUFACTURED BY

THE H. B. CAMP COMPANY

AULTMAN, OHIO.

INDEX OF ADVERTISERS.

A

	PAGE
Abendroth & Root Mfg. Co., boilers	xx
American Bell Telephone Co	xviii
American Electric Telephone Co., long-distance telephones	xviii
American Electrical Works, insulated wire	i
American Tool Works Co	viii
Armington & Sims Co., engines	ix
Automatic Switch Co	415

B

Babcock & Wilcox Co	xx
Baker & Co., platinum	v
Ball & Wood Co., engines	xv
Barnes Co., The Wallace	xvi
Berlin Iron Bridge Co	415
Bibber-White Co	x
Bogart Co., A. L	viii
Brady, T. H	416
Bristol Co	i
Brixey, W. R., Day's Kerite wires and cables	i, xiv
Brown-Bierce Co	ix
Brush Electric Co	
Buckeye Electric Co	iii
Bullock Electric Mfg. Co	ix
Bullock Mfg. Co., M. C	ix
Bunnell & Co., J. H., dry batteries	i

C

Camp Co., H. B	xi
Central Electric Co., electrical supplies	iii
Central Manufacturing Co	iv
Chase & Co., L. A	xi
Cherry Electric Works	415
Chicago Edison Co	416
Columbia Incandescent Lamp Co	i
Crocker-Wheeler Electric Co	i
Crofton Storage Battery Co	416
Cross Electrical Co	iv
Crown Woven Wire Brush Co	viii
Cutter Electrical and Mfg. Co., circuit-breakers	xiv

D

Day's Kerite, insulated wire	i, xiv
De Mary Quick-Break Switch Co	415
De Veau & Co	xvi
Diehl Manufacturing Co	vii
Dixon, Jos., Crucible Co., belt dressing	v
Duval, E. S., Jr., patents	416

E

Eastern Electric Cable Co	xx
Eddy Electric Manufacturing Co	i
Electric Appliance Company, supplies	i
Electric Novelty Mfg. & Construction Co	xvii
Electric Storage Battery Co	
Electrical Engineer Institute of Correspondence Instruction	415
Empire China Works, porcelain specialties	viii
Eppinger & Russell Co., Valentine subway electrical conduit	v

F

Faraday Carbon Co., carbons	viii
For Sale	415
Forest City Electric Works	xiv
Fort Wayne Electric Corporation	xix
Frink, I. P	xx

G

Garvin Machine Co	viii
Garton-Daniels Electric Co	
General Electric Co	xi

H

Hammacher, Schlemmer & Co., spring wires	x
Hart & Hegeman, electric switches	
Hawley & Hoops	415
Holtzer-Cabot Electric Co	

I

India Rubber and Gutta Percha Insulating Co	viii
International Correspondence Schools	416

J

Jahl & Co	iv

K

K. & W. Company	
Kerite	i, xiv
Keystone Electrical Instrument Co	xiv
Keystone Telephone Co	xviii
Kirmayer & Oelling	x
Klein & Son, Mathias	416
Kline & Co., Wm	iv
Kokomo Telephone & Electric Co	xvii

L

Leffel & Co., Jas	xx
Lehigh Valley Creosoting Co., creosoted lumber	xvii
Lombard Water-Wheel Governor Co	xx

M

McLennan & Co., K	xiv
Marietta Manufacturing Co	vi
Marshall, Wm., condensers	ix
Maryland Telephone Mfg. Co	xvii
Massachusetts Chemical Co	i
McIntire Co., The C	x
McKenney & Waterbury	iv
Manus Electric Co	xvii
Moloney Electric Co	x
Monarch Manufacturing Co	ix
Montauk Multiphase Cable Co	viii
Munsell, Eugene	415

N

National Carbon Co	xviii
National India Rubber Co	i
Naugle, Holcomb & Co	x
New England Engineering Co	xv
New York & Ohio Co	
New York Insulated Wire Co., Grimshaw wires and cables	i
New York Telephone Co	i
Newton Appliance Co	i
Novelty Electric Co., supplies	x

O

Ohio Electric Specialty Mfg. Co	viii
Okonite Co., insulated wires and cables	i, xiii, xx
Ostrander, W. R., & Co., supplies	viii

P

Pacific Electric Co	iv
Paiste, H. T., Co	xvii
Partrick, Carter & Wilkins	415
Pass & Seymour	
Pennsylvania Electric Co., telephone supplies	xvii
Perfection Supply Co	i
Peru Electric Manufacturing Co	
Phillips Insulated Wire Co., wire	xiv
Phœnix Carbon Co	
Phœnix Glass Co	i, v

R

Reading Electrical Manufacturing Co	iv
Ritchie & Sons	
Roche, Wm	iv
Rochester Electric Motor Co	iv
Rodrigues, M. R	xiv
Roebling's Sons Co., John A	xx
Rose Polytechnic Institute	i
Royce & Mareau, electrical supplies	xvi

S

Safety Insulated Wire & Cable Co	416
St. Louis Electrical Supply Co	v
Sawyer-Man Electric Co	
Schiff, Jordan & Co	
Schoonmaker, A. O	415
Sipe & Sigler	
Solar Carbon & Manufacturing Co	viii
Sprague Electric Co	ii
Standard Paint Co	xiv
Standard Telephone & Electric Co	xvii
Standard Underground Cable Co	i
Stanley Electric & Manufacturing Co	vi
Stephenson Co., Ltd., John	xx
Sterling Electric Co	xvi
Sterling Supply & Manufacturing Co	iv
Stromberg-Carlson Telephone Mfg. Co	xvii
Swett & Lewis	xvi

U

U. S. Desk & File Co	iv

V

Vance Electric Co	vi
Varley Duplex Magnet Co	415
Viaduct Mfg. Co., telephones, etc	416
Vulcan Foundry Co	xx

W

Walker Co	vi
Wanted	
Warren-Medbery Co	xv
Washington Carbon Co	iii
Wells, Heber	i
Western Electric Co	v
Western Telephone Construction Co	xviii
Westinghouse Electric & Mfg. Co	xv
White & Co., J. G., engineers and contractors	415
Wurdack, Wm	416

CLASSIFIED LIST.

Alternators.
Warren-Medbery Co.

Arc Lamps. (See "Lamps.")

Arresters.
Garton-Daniels Electric Co.

Batteries, Primary.
Bunnell & Co., J. H.
Jahl & Co.
Peru Electric Mfg. Co.
Roche, Wm.

Batteries, Storage.
Crofton Storage Battery Co.
Electric Storage Battery Co.
Sipe & Sigler.

Battery Material.
Bunnell & Co., J. H.

Bells.
Holtzer-Cabot Electric Co.
Ostrander & Co., W. R.

Belt Dressing.
Dixon Crucible Co., Joseph.

Boilers.
Abendroth & Root Mfg. Co.
Babcock & Wilcox Co., The
Stirling Co., The

Books, Technical.
American Technical Book Co.
Electrical Review Pub. Co.

Bridges, Floors, Cranes (Iron).
Berlin Iron Bridge Co.

Brushes, Dynamo.
Crown Woven Wire Brush Co.
Goldmark & Wallace.
K. & W. Co.
Ohio Electric Specialty Mfg. Co.
Perfection Supply Co.
Washington Carbon Co.

Buildings and Roofing (Iron).
Berlin Iron Bridge Co.

Cable Hangers.
Standard Underground Cable Co.

Carbon Points.
Faraday Carbon Co.
National Carbon Co.
Reisinger, Hugo.
Schiff, Jordan & Co.
Solar Carbon & Mfg. Co.
Washington Carbon Co.

Cars.
Stephenson Co., John.

Chemists.
Massachusetts Chemical Co.

Circuit Breakers.
Cutter Electrical & Mfg. Co.

Climbers.
Klein & Son, Mathias.

Coal Mining Machinery.
General Electric Co.

Commutator Bars and Repairing.
Forest City Electric Works.
McLennan & Co., K.

Condensers (Electric).
Marshall, Wm.

Conduits.
Eppinger & Russell Co.
Lehigh Valley Creosoting Co.
Sprague Electric Co.
The H. B. Camp Co

Connectors and Terminals.
McIntire Co., The C.

Dynamos and Motors.
Bullock Electric Mfg. Co.
Central Electric Co.
Crocker-Wheeler Elec. Co.
Eddy Electric Mfg. Co.
Fort Wayne Electric Corporation.
General Electric Co.
Rochester Electric Motor Co.
Sprague Electric Co.
Stanley Electric Mfg. Co.
Walker Co.
Westinghouse Electric & Mfg. Co.

Electric Locomotives.
General Electric Co.

Electric Novelties.
Rodrigues, M. R.

Electrical Instruments.
Central Electric Co.
Cherry Electrical Works.
General Electric Co.
Keystone Electrical Instrument Co.

Electrical Supplies.
Bibber-White Co.
Bunnell & Co., J. H.
Central Electric Co.
Electrical Appliance Co.
Holtzer-Cabot Electric Co.
Jahl & Co.
K. & W. Co.
Novelty Electric Co.
Partrick, Carter & Wilkins.
Peru Electric Mfg. Co.
Reading Electrical Mfg. Co.
Royce & Mareau.
Western Electric Co.

Engineers and Contractors.
Naugle, Holcomb & Co.
New England Engineering Co.
White & Co., J. G.
Wurdack, Wm.

Engineers, Consulting.
Nagle & Ball.

Engines.
Armington & Sims Co.
Ball & Wood Co.
Ide & Sons, A. L.
Monarch Mfg. Co.

Fans and Fan Motors.
Central Electric Co.
Diehl Mfg. Co.
Edison Mfg. Co.
General Electric Co.
Gordon-Burnham Battery Co.
Hunter & Co., J. C.
Marietta Mfg. Co.

Fixtures, Gas and Electric.
McKenney & Waterbury.

Fuse Wire and Links.
General Electric Co.
McIntire Co., The C.
Shawmut Fuse Wire Co.

Gas-Lighting Apparatus.
Bogart, A. L.

Globes, Shades, Etc.
Frink, I. P.
Phœnix Glass Co.

Graphite.
Dixon Crucible Co., Jos.

Ground Detectors.
Wood & Comer, Ltd.

Hard Rubber.
American Hard Rubber Co.

Hotels.
Gerlach, The.
Gilsey House.

House Goods.
Central Electric Co.
Ostrander & Co., W. R.
Pacific Electric Co.
Partrick, Carter & Wilkins.

Incandescent Lamps.
(See "Lamps.")

Instruments (Testing and Recording.)
Bristol Co., The
Cherry Electric Co.
General Electric Co.
Keystone Electrical Instrument Co.
Westinghouse Electric & Mfg. Co.
Whitney Electrical Instrument Co.

Insulators and Insulating Material.
Central Electric Co.
Empire China Works.
Standard Paint Co.
Standard Underground Cable Co.
Sterling Supply & Mfg. Co.

Lamps, Arc.
Diehl Mfg. Co.
Fort Wayne Electric Corporation.
General Electric Co.
International Arc Lamp Co.
Jandus Electric Co.
Standard Thermometer & Electric Co.
Walker Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Lamps, Incandescent.
American Incandescent Lamp Co.
Buckeye Electric Co.
Columbia Incandescent Lamp Co.
Edison Min. & Dec. Lamp Dept.
General Electric Co.
Jersey Electric Co.
K. & W. Co.
Lynn Incandescent Lamp Co.
New York & Ohio Co.
Sawyer-Man Electric Co.
Warren Electric & Specialty Co.
Westinghouse Electric & Mfg. Co.

Launches, Electric.
Electric Launch Co.

Lightning Arresters.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Machine Tools.
American Tool Works Co.
Garvin Machine Co.

Magnets.
Spilldorf, C. F.
Varley Duplex Magnet Co.

Mast-Arms.
Brady, T. H.

Mica.
Munsell, Eugene.
Schoonmaker, A. O.

Non-Magnetic Watches.
Becken, A. C.

Oil Filters.
Burt Mfg. Co.

Patent Solicitors.
Duvall, Edw. S.
Lyons & Bissing.

Pattern Letters.
Wells, Heber.

Platinum.
Baker & Co.

Pole Climbers.
Barron & Co., Jas. S.
Klein & Son, Mathias.
Oshkosh Logging Tool Co.

Poles, Brackets, Pins, Etc.
Central Electric Co.
Central Mfg. Co.
Locke, Fred M.
Naugle, Holcomb & Co.

Porcelain Manufacturers.
Empire China Works.

Rail Bonds.
Forest City Electric Co.

Railway Specialties (Electric).
Central Electric Co.
Electric Appliance Company.
General Electric Co.
Novelty Electric Co.
Sterling Supply and Mfg. Co.
Vulcan Foundry Co.
Walker Co.
Western Electric Co.
Westinghouse Elec. and Mfg. Co.

Reflectors.
Frink, I. P.

Schools.
Electrical Engineer Institute of Correspondence Instruction.
International Corresp. Schools.
Rose Polytechnic Schools.

Second-Hand Apparatus.
Chicago Edison Co.

Steam Engine Stops.
Monarch Mfg. Co.

Steel Spring Wire.
Hammacher, Schlemmer & Co.
Wallace Barnes Co.

Storage Batteries.
Crofton Storage Battery Co.
Electric Storage Battery Co.
High Tension Electric Storage Co.
Sipe & Sigler.

Stokers.
American Stoker Co.

Switchboards.
American Electric Telephone Co.
Central Electric Co.
General Electric Co.
Western Electric Co.
Western Telephone Construction Co.

Switches, Etc.
Automatic Switch Co.
Central Electric Co.
De Mary Quick-Break Switch Co.
General Electric Co.
Hart & Hegeman Mfg. Co.
Newton Appliance Co.
Paiste Co., H. T.
Utica Electrical Mfg. & Supply Co.

Telephone Woodwork.
The Cabinet Mfg. Co.

Telephones.
American Bell Telephone Co.
American Elec. Telephone Co.
De Veau & Co.
Kokomo Telephone & Electric Co.
Lockwood L. D. T. & T. Co.
Mianus Electric Co.
New York Telephone Co.
Pennsylvania Electric Co.
Phœnix Telephone Co.
St. Louis Electrical Supply Co.
Standard Telephone & Electric Co.
Sterling Electric Co.
Stromberg-Carlson Telegraph Mfg. Co.
Viaduct Mfg. Co.
Western Electric Co.
Western Telephone Construction Co.

Thermo-Electric Generators.
Thermo-Electric Co.

Tools.
American Tool Works Co.
Hammacher, Schlemmer & Co.

Transformers.
Ft. Wayne Electric Corporation.
Moloney Electric Co.
New York & Ohio Co.
Westinghouse Electric & Mfg. Co.

Tubes.
Akron Insulator and Marble Co.

Turbine Governors.
Lombard Water-Wheel Gov. Co.

Water-Wheels.
American Impulse Wheel Co.
Leffel & Co., Jas.

Wires and Cables.
American Electrical Works.
Ansonia Electrical Co.
Brixey, W. R. (Kerite).
Central Electric Co.
Crefeld Electrical Works.
Eastern Electric Cable Co.
Electric Appliance Company.
General Electric Co.
Hammacher, Schlemmer & Co.
India Rubber & Gutta Percha Insulating Co.
Montauk Multiphase Cable Co.
National India Rubber Co.
New York Insulated Wire Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., John A.
Safety Insulated Wire & Cable Co.
Standard Underground Cable Co.

X-Ray Apparatus.
Kirmayer & Oelling
Knott Apparatus Co., L. E.
Ritchie & Sons.
Swett & Lewis Co.

THE STANDARD

OKONITE TRADE MARK

FOR RUBBER INSULATION...

OKONITE TRADE MARK

OKONITE WIRES,
OKONITE TAPE,
MANSON TAPE,
CANDEE W. P. WIRE,

FOR LIGHTING AND POWER.

OKONITE TRADE MARK

WE

Are the largest contractors to the U. S. Gov't for Submarine Cables...

OKONITE TRADE MARK

THE OKONITE CO., Ltd.,

(POSTAL TELEGRAPH BUILDING)

253 BROADWAY, NEW YORK.

GENERAL WESTERN AGENTS:
CENTRAL ELECTRIC CO.,
Chicago, Ill.

RECEIVED THE ONLY MEDALS OF AWARD FOR RUBBER-COVERED WIRES AND CABLES.

PARIS, 1867. WORLD'S FAIR, CHICAGO, 1893. PHILADELPHIA, 1876.

DAYS KERITE

INSULATED WIRES AND CABLES.

Aerial, Underground, Submarine, Interior,
Telephone, Telegraph, Power and Lighting.

KERITE TAPE.

W. R. BRIXEY, Sole Manufacturer.

California Electrical Works, SAN FRANCISCO.
New Orleans Electric Company, NEW ORLEANS.

203 BROADWAY, NEW YORK.

Wallace Electric Co., CHICAGO.
M. Du Perow, WASHINGTON.
Buffalo Engine Works, BUFFALO, N. Y.

FOREST CITY ELECTRIC CLEVELAND O. **ROLL DROP** COMMUTATOR BARS HAVE STOOD THE TEST OF TIME.

Upon Receipt of this Coupon we will Send Free a Sample Stick of

GALE'S COMMUTATOR COMPOUND

50 Cents per Stick. $5.00 Per Dozen.

The only article that will prevent sparking. Will keep the commutator in good condition and prevent cutting. Absolutely will not gum the brushes.

It will put that HIGH GLOSS ON THE COMMUTATOR you have so long sought after.

FOR SALE BY ALL SUPPLY HOUSES, OR

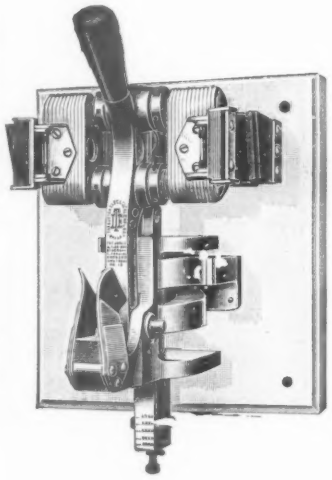
Name.....
Address.....
E. R.

K. McLENNAN & CO.,
Sole Manufacturers,
909 TITLE AND TRUST BUILDING, CHICAGO.

PREMIER PRODUCTS.

Electric Motors of all sizes. Also Punch and Die work. Send sample or drawing for estimate. High grade only.

M. R. Rodrigues, 17 Whipple St., Brooklyn, N. Y.



We manufacture not only Single and Double Pole Circuit Breakers of capacity up to 8,000 amperes, but also Double Pole, Double Coil and Triple Pole instruments, suitable for overload only, for underload only, and for over and underload combined, either direct or alternating current.

I-T-E

CIRCUIT BREAKERS

CUTTER ELECTRICAL CO., PHILADELPHIA

WEATHERPROOF WIRE.

WEATHER-PROOF TRADE MARK "O.K." LINE AND HOUSE WIRES

AGENCIES:
WESTERN ELECTRIC CO., New York.
ELECTRIC APPLIANCE CO., Chicago.
PETTINGELL-ANDREWS CO., Boston.
ELECTRICAL ENGINEERING CO., Minneapolis.
ST. LOUIS ELECTRICAL SUPPLY CO., St. Louis.
THE BRADFORD BELTING CO., Cincinnati.

Phillips Insulated Wire Co.,
Office and Factory, PAWTUCKET, R. I.

P AND B INSULATING COMPOUNDS

ARE THE STANDARD.

P AND B ELECTRICAL COMPOUNDS.

P AND B INSULATING TAPE.

P AND B ARMATURE AND FIELD COIL VARNISH.

P AND B RUBEROID MOTOR CLOTH.

Manufactured by THE STANDARD PAINT COMPANY,
Chicago Office, 189 Fifth Ave. 81-83 JOHN STREET, N. Y. Write for Particulars.

SWITCHBOARD VOLTMETERS

Ammeters, Ground Detectors and Differential Voltmeters.

We meet all the requirements of modern Central Stations or Isolated Plants, whether using direct or alternating-current circuits.

Our instruments are constant and durable, sensitive and accurate, pleasing in appearance and always correct.

We also manufacture a full line of Portable Instruments. Send for our complete catalogue.

Type "K."
Illuminated Dial.

Keystone Electrical Instrument Co.,
Ninth Street and Montgomery Avenue,
PHILADELPHIA.

NEW YORK, 15 Cortlandt. CHICAGO, 807 Ashland Block.